QUANTA CHEMISTRY

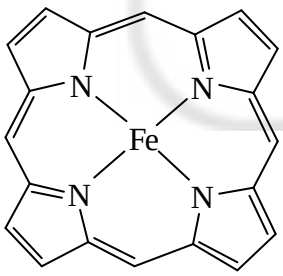
An Institute of Chemical Sciences

CSIR-NET|IIT-GATE|IIT-JAM |Other Msc. Entrance

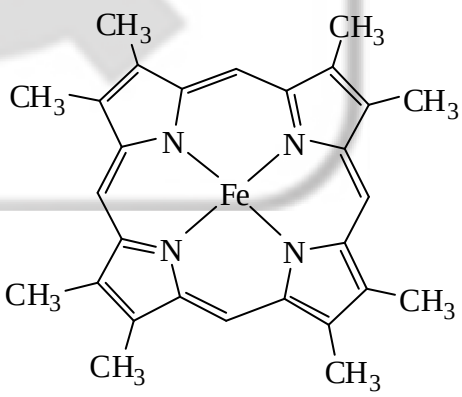
DPP-(1) – BIOINORGANIC

1. How many no. of double bonds are there in porphin molecule?
   (a) 12 (b) 11 (c) 10 (d) 9
2. Porphin molecule is:
   (a) Aromatic (b) Anti aromatic (c) Non-aromatic (d) Homo-aromatic
3. How many nitrogen atoms are coordinated with a macrocylic porphin ring?
   (a) 2 (b) 3 (c) 4 (d) 5
4. Porphyrin ligand is more selective for metal atoms than crown ethers because
   (a) It is non-rigid macrocylic ligand
   (b) It is more rigid macrocyclic ligand due to conjugated system of π-bonds.
   (c) The macrocyclic ligand has non-conjugated system
   (d) None of the above
5. Which metals can porphyrin accomodate?
   (a) Metals of 3rd transition series (b) Bigger size atoms
   (c) Metals of 1St transition series (d) All metals
6. The structure of Fe-protoporphyrin is:

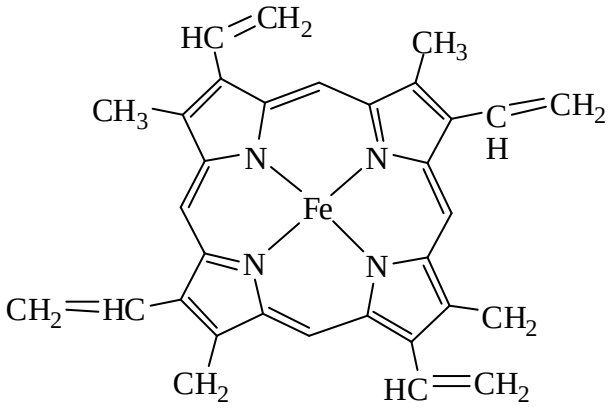
(a)



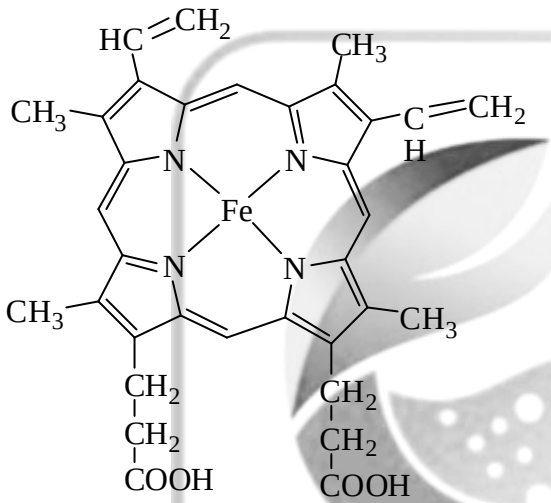
(b)



(c)



(d)



7. Iron – protoporphyrin is a :
   (a) Heme group
   (b) Non-heme group
   (c) Normal metallo porphyrin like any other
   (d) None

8. The oxidation state of Fe in iron-protoporphyrin-IX is:
   (a) + 3 (b) + 2 (c) + 4 (d) None

9. Active site of hemoglobin is:
   (a) Fe^{2+} (b) Fe^{3+} (c) Fe^{4+} (d) None

10. Role of hemoglobin is to:
   (a) Store O_2
   (b) Transport O_2 in vertibration and other animals (from lungs or gills to muscle tissues)
   (c) Electron transfer
   (d) O_2 storage in some invertebrates arthropods.

11. Coordination number of Fe in Deoxy Hemoglobin is

(a) 4 (b) 3 (c) 6 (d) 5

12. Between 2 pyrrole units in porphin the bridge is of:

(a) Ethene (b) Methine (c) Propene (d) Butene

13. Colour of deoxyhemoglobin is and is due to:

(a) Violet blue due to $\pi - \pi^*$ transition

(b) Violet blue due to $\sigma - \pi^*$ transition

(c) Red due to ligand – metal charge transfer

(d) Red due to $\pi - \pi^*$ transition.

14. Colour of oxyhemoglobin is and is due to respectively.

(a) Violet blue due to $\pi - \pi^*$ transition

(b) Violet blue due to $\sigma - \pi^*$ transition

(c) Red due to ligand to metal charge transfer

(d) Red due to $\pi - \pi^*$ transition.

15. Hemoglobin is present in:

(a) White blood cells (b) Red blood cells (erythrocytes)

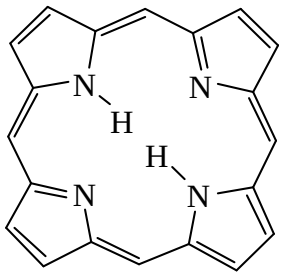
(c) lymphocytes (d) None

ANSWER KEY

1.b	6.d	11.d
2.a	7.a	12.b
3.c	8.b	13.a
4.b	9.a	14.d
5.c	10.b	15.b

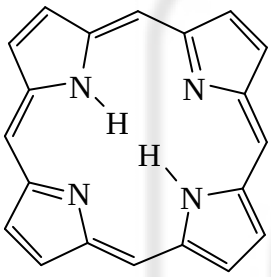
HINTS & SOLUTIONS

1.Sol. Number of double bonds in porphin molecule are 11.



Porphin Molecule

So, correct option is (b)

2.Sol. 

Porphin molecule is (planar)

It is following hukcle rule $\rightarrow 4n + 2$

Hence, Aromatic

So, correct option is (a)

3.Sol. These are macrocylic compounds in which a metal is coordinated to four N-atoms in a square plane of porphyrin ring.

So, correct option is (c)

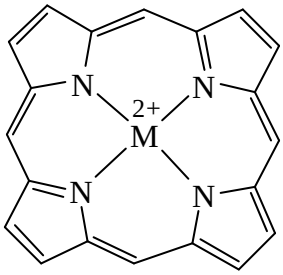
4.Sol. Porphyrin ring $\rightarrow$ Macrocylic ligand

Metalloporphyrin $\rightarrow$ Macrocyclic complex

Macrocyclic ligand has a planar conjugated system of π-bonds around its perimeter, therefore it is more rigid Macrocyclic ligand than crown ethers.

Hence, the ligand is more selective for certain metal atoms as compare to crown ethers.

So, correct option is (b)

5.Sol. 

In metalloporphyrin complexes the inner hydrogen atoms are replaced by dipositive metal ions.

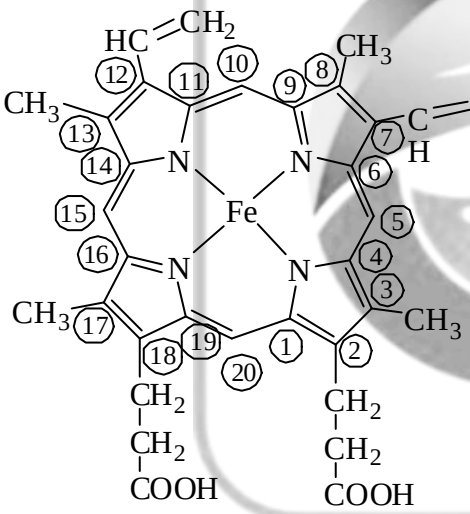
The porphyrin rings are rigid because of the delocalization of the π-electrons

Size of the cavity in the centre of porphyrin ring is ideal for accommodation of metal ions of 1st transition series.

If the metal ion is too small such as Ni^{2+} the ring rearrange itself to give closer approach to metal ion.

If the metal ion is too large, it can not fit into the cavity and occupies position above the ring.

So, correct option is (c)

6.Sol. 

4-pyrrole rings

2 vinyl (7 and 12)

4 methyl (3, 8, 13 and 17)

20 carbon atoms

20-carboxyethyl (2 and 18)

So, correct option is (d)

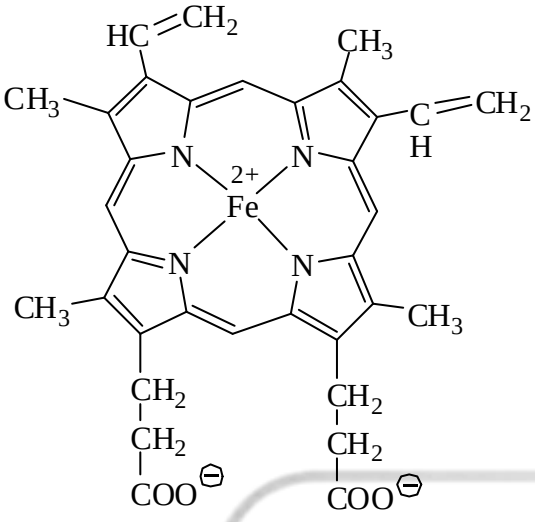
7.Sol. Iron-proto-porphyrin is a derivative of porphyrin.

Iron as a metal with porphyrin is a heme group (prosthetic group)

Prosthetic means – a non-protein group forming part of or combined with protein

So, correct option is (a)

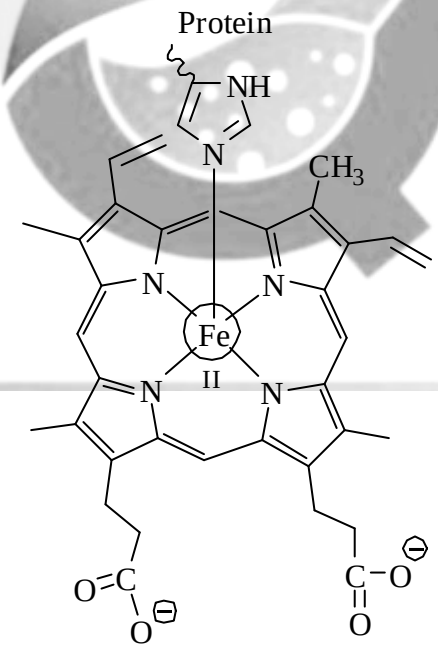
8.Sol.



Fe is in +2 oxidation state

So, correct option is (b)

9.Sol. Whatever reaction takes place, will be occurred at Fe^{2+}

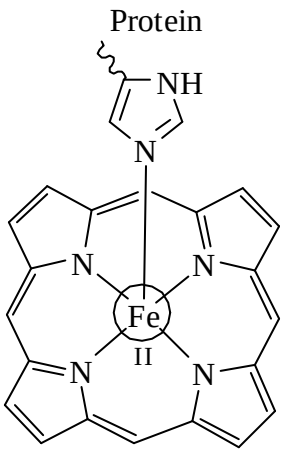


So, correct option is (a)

10.Sol. Hemoglobin picks O_2 from lungs or gills and releases in muscle tissues.

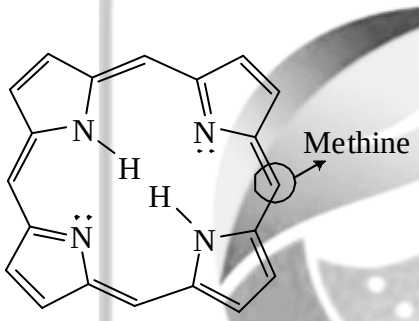
So, correct option is (b)

11.Sol. Coordination number 5



So, correct option is (d)

12.Sol. Bridge contains methine



So, correct option is (b)

13.Sol. Double bond will give electron in antibonding orbital of π.

Hence colour generates

So, correct option is (a)

14.Sol. So, correct option is (d)

15 Sol. so correct option is (b)

QUANTA CHEMISTRY

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DPP-(2) – BIOINORGANIC

1. How many α and β globin proteins are present in Hemoglobin.

   (a) 2α and 2β (b) 4α and 2β (c) 2α and 4β (d) 4α and 4β

2. In deoxy hemoglobin Fe^{2+} is :

   (a) In plane (b) Out of plane (c) Low spin (d) None

3. Myoglobin function is to:

   (a) Transfer e^- (b) Stores O_2 in muscle tissues

   (c) Binds H^+ and $HCO_3^{\ominus}$ (d) Transfer oxygen to lungs

4. O_2 binds Hb in which state

   (a) Triplet (b) Singlet and Triplet both

   (c) Singlet (d) None

5.. The Cooperative binding of O_2 in hemoglobin is due to

   (a) a decrease in size of iron followed by changes in the protein conformation.

   (b) an increases in size of iron followed by changes in the protein conformation.

   (c) A decrease in size of iron that is not accompanied by the protein conformational changes.

   (d) An increase in size of iron that is not accompanied by the protein conformational changes.

6.. In deoxyhemoglobin Fe is in _____ spin. While in oxyhemoglobin Fe is in _____ spin.

   (a) High and low respectively (b) Low and high respectively

   (c) High and high respectively (d) Low and low respectively

7. Under physiological condition, oxygen is binding to hemoglobin and myoglobin, the binding curve and its pH dependence, respectively are

   (a) Sigmoidal and pH dependent; hyperbolic and pH independent.

   (b) Sigmoidal and pH independent; hyperbolic and pH dependent.

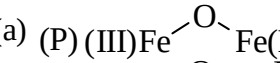
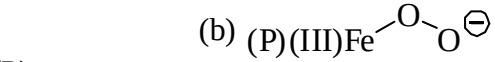
   (c) Hyperbolic and pH independent; sigmoidal and pH dependent.

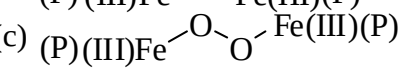
   (d) Hyperbolic and pH dependent; sigmoidal and pH independent.

8. The Fe – N porphyrin bond distance in deoxy and oxy-hemoglobin, respectively, are

(a) ~ 2.1 and 2.0 Å (b) ~ 2.0 and 2.0 Å (c) ~ 2.2 and ~ 2.3 Å (d) ~ 2.3 and 2.5 Å

9.. In the absence of bound globin chain, heme group on exposure to O_2 gives the iron-oxygen species (P represents porphyrin ring).

(a)  (b) 

(c)  (d) (P) Fe(IV) = 0

10. Role of globin protein:

(a) prevents Fe(II) oxidation (b) Oxidizes Fe(II) oxidation

(c) Forms Hematin (d) None

11. Affinity of Hb and Mb towards O_2 is respectively.

(a) High and low partial pressure of O_2

(b) Low and high partial pressure of O_2

(c) Low and low partial pressure of O_2

(d) High and High partial pressure of O_2

12. Affinity of Co is more towards Fe(II) in deoxyhemoglobin but O_2 binds there because

(a) O_2 is strong field

(b) O_2 has more electrons

(c) O_2 forms H-bond between bound oxygen and distal protein

(d) O_2 is in singlet state

13. Cooperative effect is

(a) pH dependent

(b) pH independent

(c) O_2 addition do not effect other O_2 addition

(d) None

14. According to the graph between partial pressure of O_2 and percentage saturation with O_2 Hb has

(a) pH = 7.4 and sigmoidal curve (b) pH = 7.4 and hyperbolic curve

(c) pH = 1.4 and sigmoidal curve (d) pH = 1.4 and hyperbolic curve

15. What is the reason behind sickle cell anemia?

(a) Because of deformed shape of hemoglobin red blood cells become sickle

(b) Due to presence of glutamic acid in one β-chain of globin proteins.

(c) Due to oxygen transport in hemoglobin

(d) Due to hydrophobic part

ANSWER KEY

1. a
2. b
3. b
4. c
5. a
6. a
7. a
8. a
9. a
10. a
11. a
12. c
13. a
14. a
15. a

HINTS & SOLUTUONS

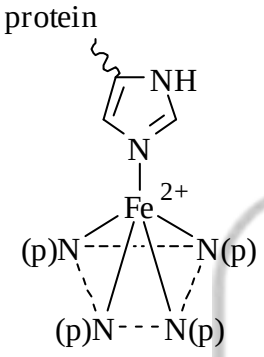
1.Sol. In hemoglobin two types of globin proteins.

$\rightarrow$ α and β are 2α and 2β

i.e. Hb is a tetramer of 2 different subunits.

So, correct option is (a)

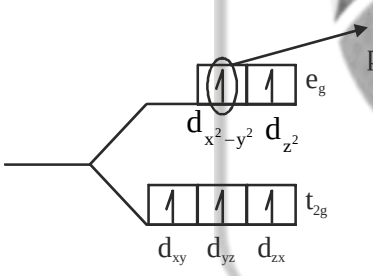
2.Sol.



$Fe = 3d^6\ 4s^2$

$Fe^{2+} = 3d^6$ (high spin)

$= t_{2g}^4\ eg^2$



Due to presence of this electron in the $d_{x^2-y^2}$ repulsion will occur with N-lone pair of porphyrin ring and Fe(II) size become too big and will become difficult to get fit in porphyrin ring.

As the structure is rigid, hence Fe(II) goes out of plane towards proximal protein.

So, correct option is (b)

3.Sol. Stores O_2 in muscle tissues and releases when required during activity for decomposition of glucose.

So, correct option is (b)

4.Sol. O_2 has π bond in singlet (O = O)

• If O_2 is in singlet than it act as strong field. And Fe has to come in low spin which is possible only with singlet and here after binding O_2 with Fe angle formed in 125 º that is it is bent and oxygen is sp^2 hybridized.

($\dot{O} - \dot{O}$) triplet

• O has 7 e^{Θ}

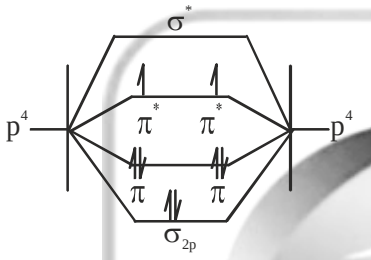
• sp^3 hybridized

• has covalent bond

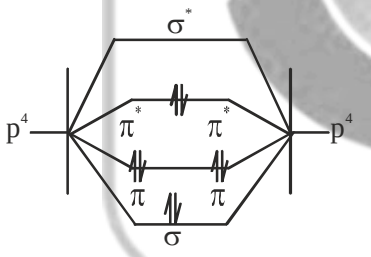
• O_2 is not strong field

• Free to move

• will not be present in bent form



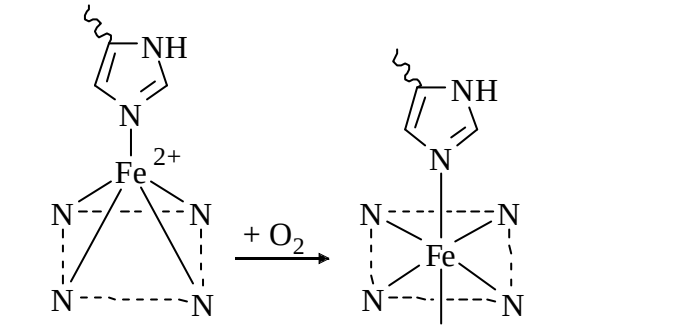
$$\text{Triplet} = s = \frac{1}{2} + \frac{1}{2} = 1; s = 2s + 1 \Rightarrow 3$$



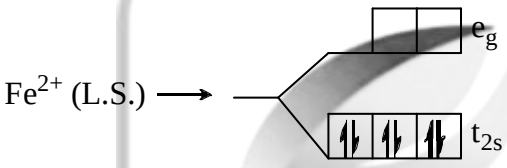
$$\text{Singlet} = s = \frac{1}{2} \Rightarrow s = 2s + 1 \Rightarrow 1$$

So, correct option is (c)

5.Sol. When O_2 tries to bind with Fe it becomes low spin from high spin and will become planar.



(deoxyhemoglobin) (oxyhemoglobin)

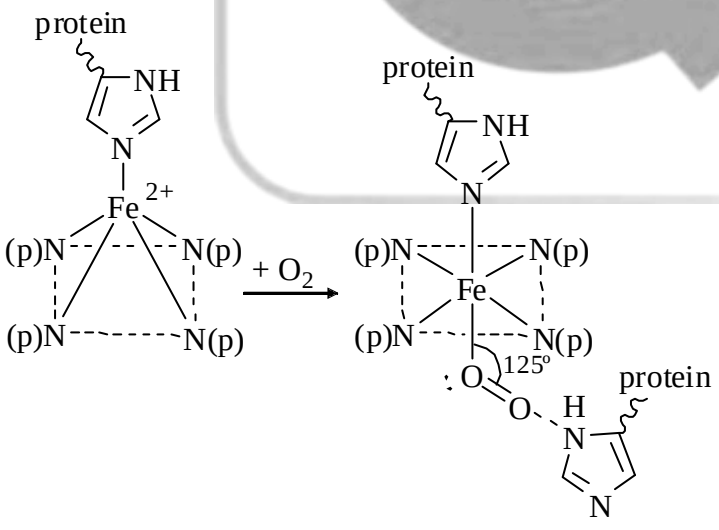


• Here no repulsion between $e^{\ominus}$ in $d_{x^2-y^2}$ and nitrogen *l*.p. of porphyrin ring.

• Hence Fe will remain in plane.

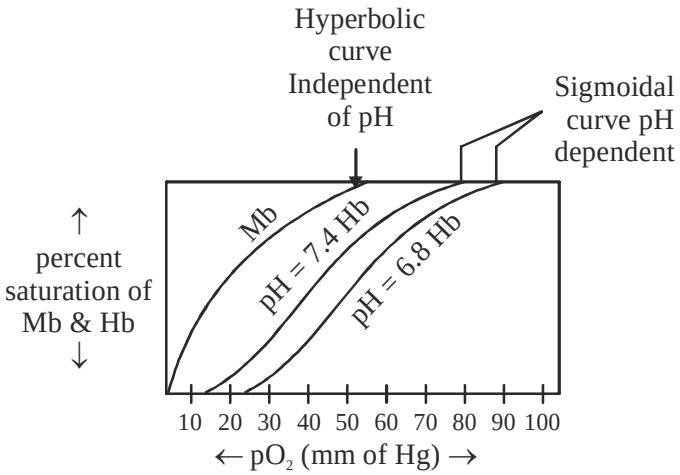
So, correct option is (a)

6.Sol.



Correct option is (a)

7.Sol.



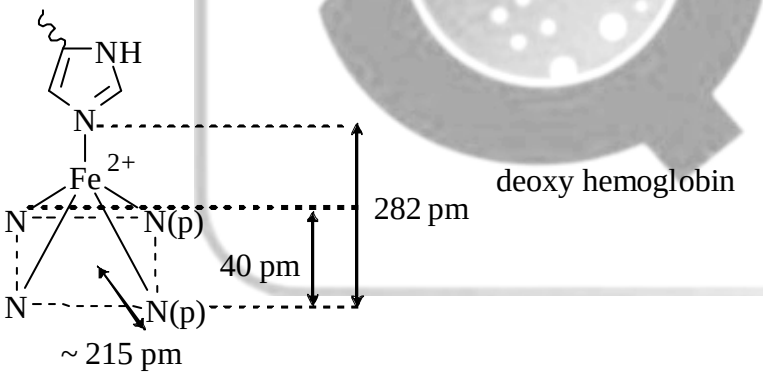
• for 'Hb':

$$\boxed{f = \frac{kpO_2^n}{1+kpO_2^n}} \rightarrow (\text{S type}) \text{ or sigamoidal curve}$$

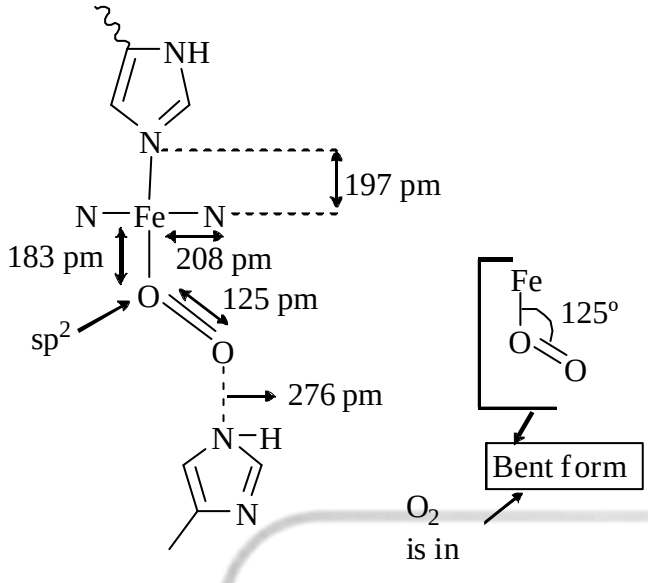
n = hill constant for Hb

$$\boxed{f = \frac{kpO_2}{1+kpO_2}} \rightarrow \text{hyperbolic} \rightarrow \text{for Mb}$$

8.Sol.



deoxy hemoglobin



Correct option is (a)

9.Sol. In the absence of globin protein

(a) $(P)\,Fe(II) + O_2 \longrightarrow (P)\,Fe(II)-O_2$

(b) $(P)\,Fe(II)-O_2 + Fe(II)(P) \xrightarrow{e^- \text{ transfer}} (P)Fe(III)-O-O-Fe(III)$ (μ – Peroxide compound)

(c) $(P)\,Fe(III)-O-O-Fe(III) \longrightarrow 2(P)Fe(IV)=O$

(d) $Fe(IV)=O + Fe(II)P \longrightarrow (P)\,Fe(III)-O-Fe(III)\,(P)$

(Hematin)
(μ-oxido complex)
or (oxido-bridge-complex)

Correct option is (a)

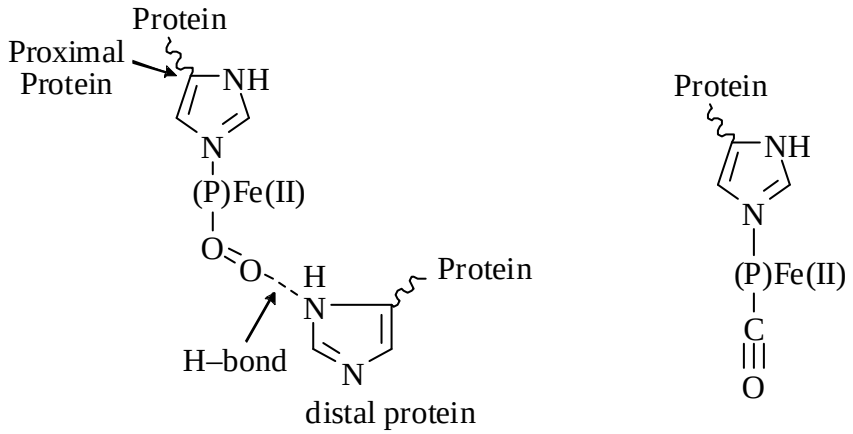
10.Sol. Globin protein surround the heme group in such a way that it prevents its oxidation and prevents formation of Hematin.

So, correct option is (a)

11.Sol. High and low partial pressure of O_2

So, correct option is (a)

12.Sol.



P-stands for porphyrin ring

Affinity of Co toward Fe^{II} is more than O_2 but O_2 forms H-bond with distal protein hence its affinity increases.

So, correct option is (c)

13.Sol. pH dependent is correct option

The phenomenon by which the addition of one O_2 molecule to hemoglobin molecule increase the rate addition of other O_2 is called co-operativity effect.

So, correct option is (a)

14.Sol. $Hb + 4O_2 \rightleftharpoons HB(O_2)_4$

$$k = \frac{\left[Hb(O_2)\right]}{\left[Hb\right]\left[pO_2^{\,n}\right]}$$

or

$$k = \frac{f}{(1-f)pO_2^n}$$

or $\boxed{f = \frac{kpO_2^n}{1+kpO_2^n}} \rightarrow$ Equation for sigmoidal curve (s-type)

n = Hill constant – under physiological conditions

$\boxed{(pH = 7.4), n = 2.8}$

So, correct option is (a)

15.Sol Because during the conversion hemoglobin becomes distorted and because of this deformed shape of hemoglobin, red blood cells becomes sickle shaped and cause Sickle Cell Anemia (SCA).

So, correct option is (a)

DPP-(3) – BIOINORGANIC

1. What conversions in hemoglobin takes place that causes sickle cell anemia?

   (a) Conversion of hemoglobin into oxyhemoglobin

   (b) Through oxygen transport in hemoglobin

   (c) Conversion of hydrophilic glutamic acid into hydrophobic valine.

   (d) None

2. Glutamic acid is replaced by what that causes sickle cell anemia?

   (a) Arginine (b) Asparagine (c) Cysteine (d) Valine

3. Which is hydrophilic or hydrophobic in hemoglobin.

   (a) Valine is hydrophilic

   (b) Glutamic acid is hydrophilic

   (c) Glutamic acid is hydrophobic

   (d) Both Glutamic and Valine acid are hydrophobic

4. What is the oxidation number of iron in methemoglobin:

   (a) Fe^{+2} (b) Fe^{+3} (c) Fe^{+4} (d) Fe^{o}

5. Methemoglobin:

   (a) Help in oxygen transfer (b) prevents oxygen transfer

   (c) contain Fe^{+2} in the heme group (d) None

6. What is the use of methemoglobin reductase?

   (a) To convert methemoglobin in our required oxyhemoglobin

   (b) It is used to produce methemoglobin

   (c) It converts of Fe^{+2} to Fe^{+3}

   (d) It is a source of H^{+}

7. The higher level of methemoglobin causes which disease:
   (a) Alzheimer's disease (b) Stroke
   (c) Methemoglobinemia disorder (d) Multiple sclerosis
8. The binding of dioxygen to methemoglobin results in:
   (a) increased affinity of dioxygen to other three heme subsunits having Fe^{2+}.
   (b) Decreased affinity of dioxygen to other three heme subunits having Fe^{2+}.
   (c) No effect on other three heme subunits.
   (d) Dioxygen do not bind with methemoglobin.
9. During the formation of oxyhemoglobin from hemoglobin and dioxygen the electron is transferred partially from
   (a) Fe^{+3} (b) Fe^{+2} (c) Fe^{IV} (d) Fe^{o}
10. The cooperative effect is pH:-
   (a) Dependent (b) Independent (c) pH has no role (d) None
11. In the muscle tissues there is _____ PO_2, ____ pH and _____ pCO_2.
   (a) Low, low, low (b) Low, low, high (c) High, high, low (d) Low, high, low
12. The active site in deoxyhemerythrin is
   (a) Fe^{+2} (b) Fe^{+3} (c) Fe^{0} (d) Fe^{+4}
13. Function of Hemerythrin is:
   (a) O_2 transport in Marine invertibrates (b) O_2 storage
   (c) $e^{\ominus}$ transfer (d) None
14. How many iron centres are in Hemerythrin?
   (a) 1 (b) 2 (c) 3 (d) 4
15. The coordination number of both Fe in deoxyhemerythrin is:
   (a) 6, 6 (b) 6, 4 (c) 6, 5 (d) 5, 5

ANSWER KEY

1.c	6.a	11.b
2.d	7.c	12.a
3.b	8.a	13.a
4.b	9.b	14.b
5.b	10.a	15.c

HINTS & SOLUTIONS

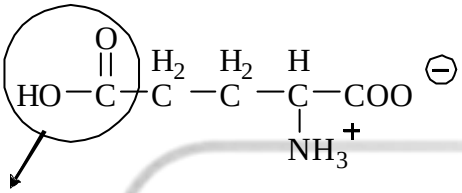
1Sol. This is due to the mutant form of hemoglobin, where hydrophillic glutamic acid in one β-chain of globin protein is replaced by hydrophobic valine which reduces the solubility of hemoglobin and prevents oxygen transport. During this conversion hemoglobin polymerizes and becomes distorted and red blood cells becomes sickle shaped, causes sickle cell anemia.

So, correct option is (c)

2.Sol. Glutamic acid in one of globin proteins is replaced by hydrophobic valine which reduces the solubility of hemoglobin and prevents oxygen transport

So, correct option is (d)

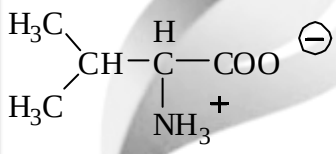
3.Sol.



Hydrophilic group increases solubility

(Glutamic acid)

Hydrophobic



decreases the solubility

(Valine)

So, correct option is (b)

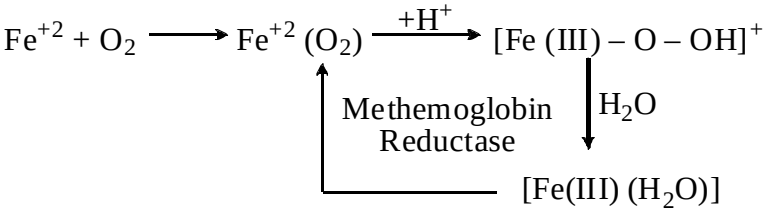
4.Sol. Methemoglobin is a metalloprotein in which the iron in the heme group is in the Fe^{3+} state, not in the Fe^{2+} of normal hemoglobin

So, correct option is (b)

5.Sol. So, correct option is (b)

The size of Fe^{3+} ion is so small that it can fit into porphyrin ring of hemoglobin without binding oxygen and therefore, it prevents transfer of dioxygen.

6.Sol. It is a NADH – dependent enzyme that converts methemoglobin back to hemoglobin.



So, correct option is (c)

7.Sol. Higher level of methemoglobin causes a disease called as methemoglobinemia which is a disorder.

So, correct option is (c)

8.Sol. The binding of dioxygen to methemoglobin results in increased affinity of dioxygen to other three heme subunits that still contain Fe^{2+} ions within the same hemoglobin molecule.

So, correct option is (a)

9.Sol. During the formation of oxyhemoglobin from hemoglobin and dioxygen, one electron is partially transferred from Fe^{2+} of heme to the bound oxygen forming a ferric superoxide complex anion.

$$Fe^{+2} + O_2 \longrightarrow Fe^{2+}-O-O$$

So, correct option is (b)

10.Sol. The cooperative effect is pH dependent. The affinity of hemoglobin for dioxygen decreases with decrease in pH. This is called bohr effect.

$\therefore$ answer is dependent.

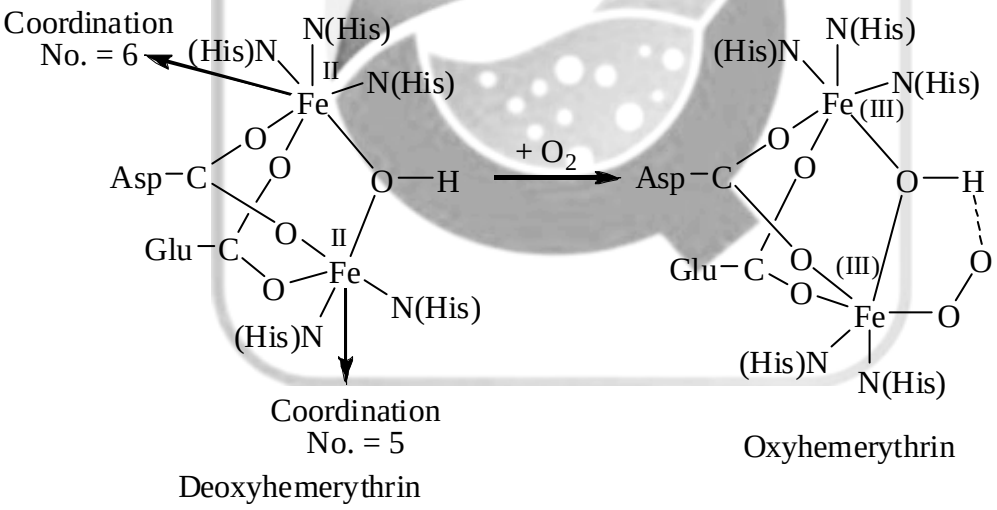
Correct option is (a)

11.Sol. The CO_2 released in muscle tissues is the end product of breakdown of glucose. CO_2 being acidic, decreases the pH in muscle tissues and lowers the pH.

The greater the muscular activity the more will be release of CO_2.

$\therefore$ In the muscles tissues, there is low PO_2, low pH and high pCO_2.

12.Sol. Fe^{+2} is the active site in deoxyhemerythrin.



Coordination No. = 5

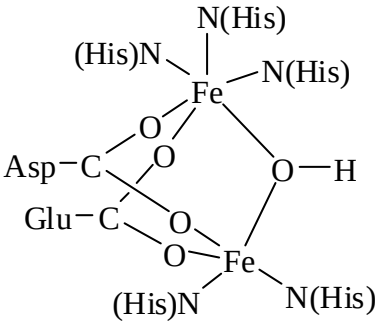
Deoxyhemerythrin

Oxyhemerythrin

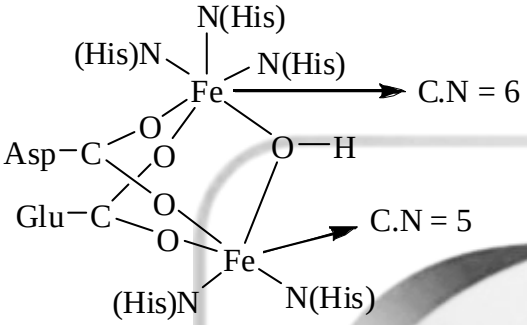
13.Sol. The function of Hemerythrin is O_2 transport in Marine invertibrates.

One molecule contains 8 subunits.

14.Sol. Hemerythrin has 2 iron centres


N(His)
(His)N
N(His)
Fe
O
O
Asp−C
O—H
Glu−C
O
O
Fe
(His)N
N(His)

15.Sol.


N(His)
(His)N
N(His)
Fe
C.N = 6
O
Asp−C
O
O—H
O
Glu−C
C.N = 5
O
Fe
(His)N
N(His)

QUANTA CHEMISTRY

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DPP-(4) – BIOINORGANIC

1. How many N(Histidine) groups are attached to Fe in Hemerythrin?

   (a) 3, 2 (b) 2, 2 (c) 2, 2 (d) 2, 4

2. What is the oxidation number of both iron in deoxyhemerythrin

   (a) +2 both (b) +2, +3 (c) +3 both (d) +3, +3

3. In oxyhemerythrin both iron have O.S

   (a) +2, +3 (b) +3, +3 (c) +2, +2 (d) +3, +4

4. The coordination number in oxyhemerythrin of both Fe is:

   (a) +6, +6 (b) +6, +5 (c) +6, +4 (d) +5, +5

5. Active site in deoxyhemocyanin is:

   (a) Fe^{II} (b) Fe^{III} (c) Cu^{I} (d) Cu^{II}

6. After formation of oxyhemerythin the bond of O–H becomes _____ and O–O–H become ____

   (a) Weak and strong respectively (b) Weak and weak respectively

   (c) Strong and strong respectively (d) Stronger and weak respectively

7. The ν_{O-O} stretching frequency for Hemocyanin is:

   (a) 850 cm^{-1} (b) 1100 cm^{-1} (c) 880 cm^{-1} (d) 750 cm^{-1}

8. Cu(I) in deoxyhemocyanin is

   (a) Colourless and diamagnetic (b) Colourless and paramagnetic

   (c) Blue colour and diamagnetic (d) Blue colour and paramagnetic

9.. The peroxide (O_2^{2-}) ion bridges in oxyhemocyanin in the mode:

   (a) $\mu-\eta^2:\eta^2$ (b) $\mu-\eta:\eta$ (c) $\mu-\eta^2:\eta$ (d) $\mu-\eta^3:\eta^2$

10. In oxyhemocyanin:

(a) There are 2Cu(II) and 2 oxygens binded with only one Cu(II)

(b) There are 2Cu(II) and 2 oxygens binded in bridge form with both Cu(II)

(c) There is only 1 Cu(II) and 2 oxygens binded with the Cu(II)

(d) There are two Cu(I) and 2 oxygens binded in bridged form with both

11. In plastocyanin how many histidine groups are present in oxidised form:

(a) 2 (b) 3 (c) 4 (d) 1

12. In reduced form of plastocyanin how many histidine groups are present?

(a) 2 (b) 3 (c) 4 (d) 1

13. The active site in plastocyanin in reduced form is

(a) Cu(II) (b) Cu(I) (c) Zn(II) (d) Zn(I)

14. The active site in plastocyanin in oxidized form is:

(a) Cu(II) (b) Cu(I) (c) Zn(II) (d) Zn(I)

15. In stellocyanin the groups attached to Cu(I) in oxidized and reduced form are:

(a) 1O of (serine), 2N of (His), 1S of (Cys)

(b) 1O of (serine), 2N of (His), 1S of (Cys), 1S(Meth)

(c) 1S of (Meth), 1S of (Cys), 2N of (His)

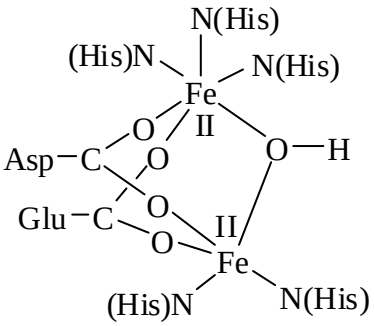
(d) 1O of (Gly), 2N of (His), 1S of (Meth)

ANSWER KEY

1.a	6.a	11.a
2.a	7.d	12.a
3.b	8.a	13.b
4.a	9.a	14.a
5.c	10.b	15.a

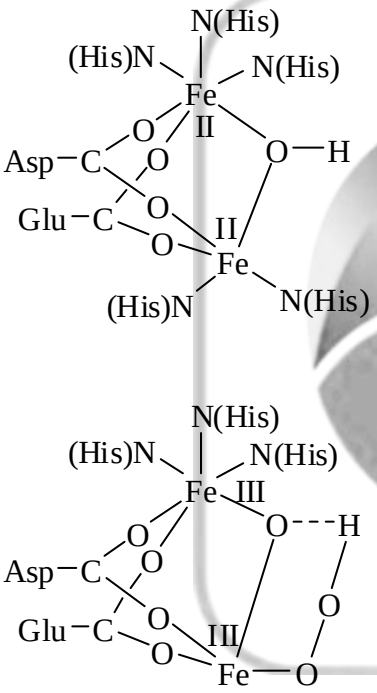
HINTS & SOLUTIONS

1.Sol.

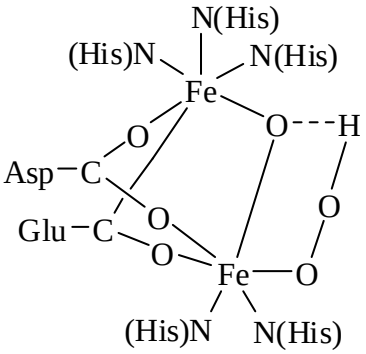


2.Sol. In deoxyhemerythrin both have +2 O.S.

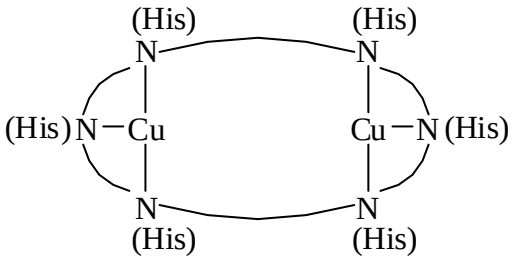
3.Sol.



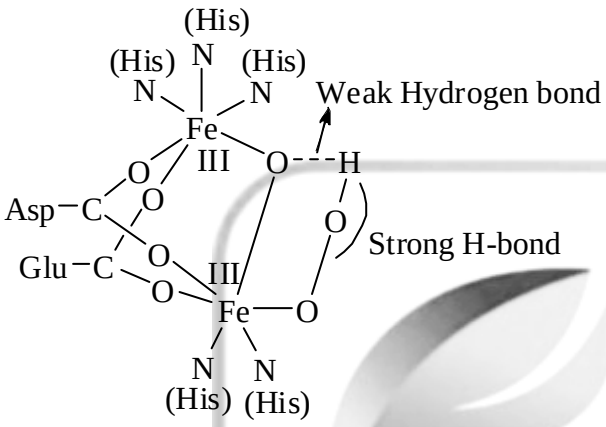
4.Sol.



5.Sol.



6.Sol. Weak and strong respectively.

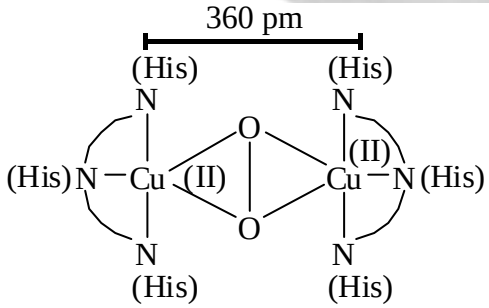


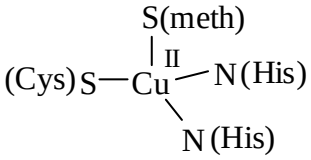
7.Sol. ν_{O-O} stretching frequency for Hemocyanin is 750 cm^{-1}.
Correct option is (d)

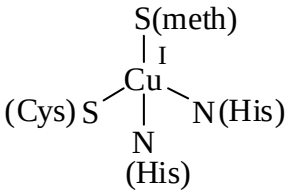
8.Sol. Cu(I) $\rightarrow 3d^{10}\ 4s^0$ in deoxyhemocyanin is colourless and diamagnetic.
$\rightarrow$ Here no d–d transition
$\rightarrow$ No LMCT takes place

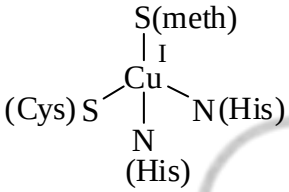
9.Sol. The peroxide (O_2^{2-}) ion bridges to two Cu^{2+} ion in the $\mu - \eta^2 : \eta^2$ mode.

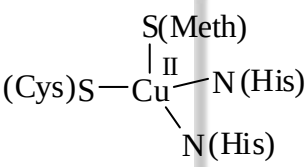
10.Sol.

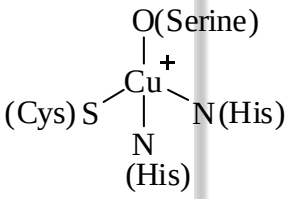


11.Sol. 

12.Sol. 

13.Sol. 

14.Sol. 

15.Sol. 

DPP-(5) – BIOINORGANIC

1. Oxidized form of stellocyanin is:

   (a) Paramagnetic, Distorted tetrahedral (b) Diamagnetic, Tetrahedral

   (c) Diamagnetic, Bipyramidal (d) Paramagnetic, Tetrahedral

2. In Azurin the colour in oxidized form is

   (a) Colourless (b) Red colour (c) Blue colour (d) None

3. How many photosystems are present in chloroplasts:

   (a) 2 (b) 1 (c) 4 (d) 5

4. Ps-II and Ps-I absorbs light radiation of:

   (a) 680 nm and 700 nm respectively (b) 700 nm and 680 nm respectively

   (c) 900 nm and 680 nm respectively (d) 680 nm and 900 nm respectively

5 In metalloenzyme the protein part is called as an _____ and a metal ion or complex metal ion is called a _____ group.

   (a) apoenzyme, prosthetic (b) prosthetic, apoenzyme

   (c) coenzyme, prosthetic (d) prosthetic, coenzyme

6. Both the ____ group and ____ respectively are sometimes called co-factors.

   (a) Prosthetic group, coenzyme (b) conenzyme, prosthetic

   (c) apoenzyme, coenzyme (d) coenzyme apoenzyme

7 Active site in Zinc Enzyme carbonic anhydrase.

   (a) OH_2 (b) Zn^{2+} (c) Zn^{+} (d) OH

8. Function of carbonic anhydrase is :

   (a) Catalyse the conversion of CO_2 to H^+ and $HCO_3^{\ominus}$

   (b) Transport of CO_2 to lungs.

(c) Catalyse the hydrolysis terminal peptide linkage of proteins.

(d) Catalyses the conversion of ethanol to acetaldehyde.

9. Water molecule bond to Zn^{2+} in carbonic anhydrase.

(a) basic (b) Amphoteric (c) acidic (d) Neutral

10. Function of Carboxypeptidase–A is

(a) Catalyse the conversion of CO_2 to H^+ and $HCO_3^{\ominus}$

(b) Transport of CO_2 to lungs

(c) Catalyse the hydrolysis terminal peptide linkage of proteins

(d) Catalyses the conversion of ethanol to acetaldehyde

11 How many amino acids are present in a protein chain of carboxy peptidase A ?

(a) 307 amino acids (b) 207 (c) 107 (d) 17

12. Chlorophylls (green colour) absorbs light radiation, they are called

(a) synthetic pigments (b) organic pigments (c) antenna pigments (d) Inorganic pigments

13. The part of chlorophyll that absorbs sunlight is

(a) photoreceptor (b) Porphyrin head (c) Storma (d) Lumen

14. Cluster of chlorophylls are known as :-

(a) Photosystem (PS) (b) Lumen (c) Storma

(d) Photoreceptor

15. Photosystem II is called

(a) $PS\text{-}II_{700}$ (b) $PS\text{-}II_{680}$ (c) $PS\text{-}II_{540}$ (d) $PS\text{-}II_{900}$

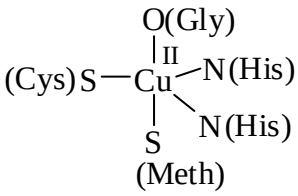
ANSWER KEY

1.a	6.a	11. a
2.c	7.d	12.c
3.a	8. a	13. a
4.a	9. c	14. a
5.a	10. c	15. b

HINTS & SOLUTIONS

1.Sol. The oxidised form of stellocyanin is paramagnetic and distorted or flattered tetrahedral. Due to John Tellor distortion.

2.Sol. Oxidized form of Azurin is blue in colour due to e^- transfer from S(cys) to Cu^{2+}.



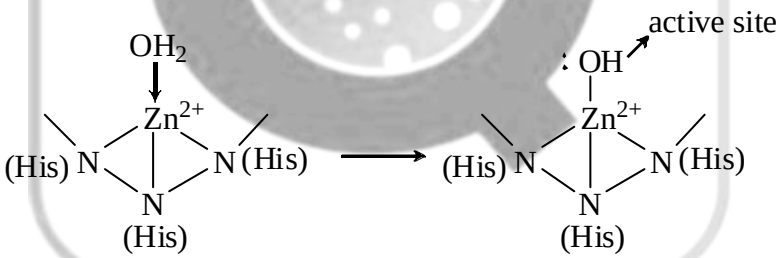
3.Sol. Two photosystems are present in chloroplasts.
(Ps – I), (Ps – II)

4.Sol. Ps-I absorbs light radiation of 700 nm
$\therefore$ Ps-I is called Ps_{700}
Ps-II absorbs light radiation of 680 nm
$\therefore$ Ps-II is called Ps_{680}

5.Sol. Heme is prosthetic group in hemoglobin.

6.Sol. Prosthetic group and coenzyme are also known as co-factors.

7.Sol. OH is the active site of carbonic anhydrase.
Zn^{2+} makes OH_2 a good acid.



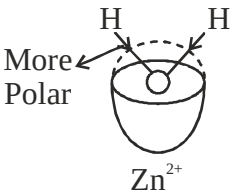
Option (d) is correct.

8.Sol. The function of carbonic anhydrase is to catalyse the conversion of CO_2 to H^+ and $HCO_3^{\ominus}$ during the transport of CO_2 to lungs by hemoglobin.

$$CO_2 + H_2O \underset{\text{Anhydrase}}{\overset{\text{Carbonic}}{\rightleftharpoons}} H^+ + HCO_3^{\ominus}$$

Option (a) is correct.

9.Sol.



$\rightarrow Zn^{+2}$ has high polarizing power and low pKa, of OH_2

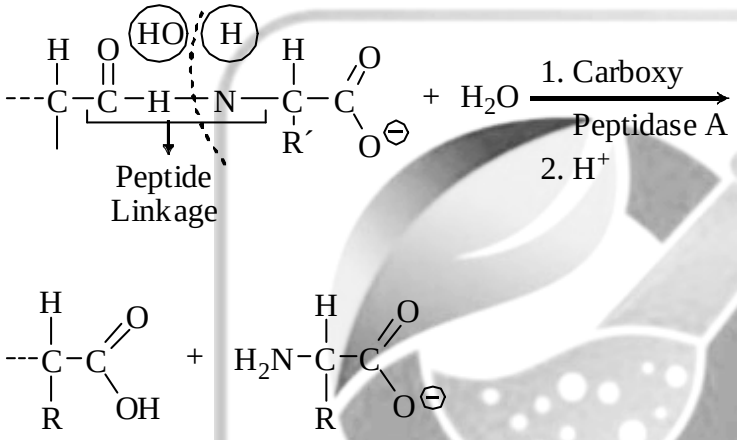
$\rightarrow$ Water molecule bound to Zn^{2+} is Acidic

$\rightarrow$ Aqua complex of metal cations are acidic

$\rightarrow$ except that of alkali metal cations as they are neutral.

Option (c) is correct.

10.Sol. Function of carboxy-peptidase A is to catalyse the hydrolysis terminal peptide linkage of proteins.



Option (c) is correct.

11.Sol. The enzyme consists of a single protein chain of 307 amino acids and one Zn^{2+} ion.

Option (a) is correct.

12.Sol. Since Chlorophylls (green color) absorbs light radiation, they are called antenna pigments.

13. Sol. Option (a) is correct.

Photoreceptor of chlorophylls absorbs sunlight.

14.Sol. Cluster of chlorophylls is known as photosystems.

Option (a) is correct.

15.Sol. Photosystem-II absorbs light radiation of 680 nm,

$\therefore$ PS-II is called PS_{680}

Option (b) is correct.

QUANTA CHEMISTRY

An Institute of Chemical Sciences

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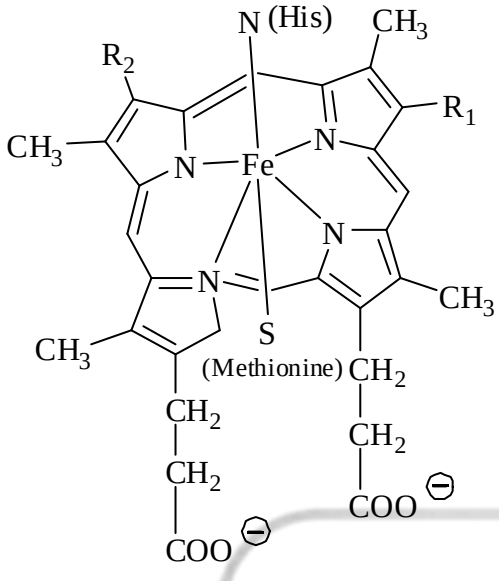
DPP-(6) – BIOINORGANIC

1. Photosystem-I releases e^{Θ} as :-
   (a) PS–I → Ferridoxin NADP → Ferrodoxin reductase
   (b) PS–I → Ferridoxin → Ferrodoxin NADP reductase
   (c) Ferridoxin → Ferridoxin → PS–I NADP reductase
   (d) Ferridoxin NADP → Ferridoxin → PS–I reductase
2. Porphyrin ring with one reduced double bond in chlorophylls is called
   (a) chlorin ring (b) porphin ring (c) Imidazole ring (d) pyrrole ring
3. Active site of chlorophyll
   (a) Mg^{+} (b) Mg^{2+} (c) Cu^{+} (d) Cu^{2+}
4. Colour of chlorophyll
   (a) Green due to $\pi - \sigma^*$ charge transfer
   (b) Green due to $\pi - \pi^*$ charge transfer
   (c) Yellow due to $\pi - \pi^*$ charge transfer
   (d) Red due to $\pi - \pi\_^*$ charge transfer
5. Cy;tochromes are:
   (a) Heme iron proteins (b) Non-heme proteins
   (c) Copper carring proteins (d) Zinc carrying enzymes

6 In the following structure cytochrome a (cyt a) will be when R_1 and R_2 are:



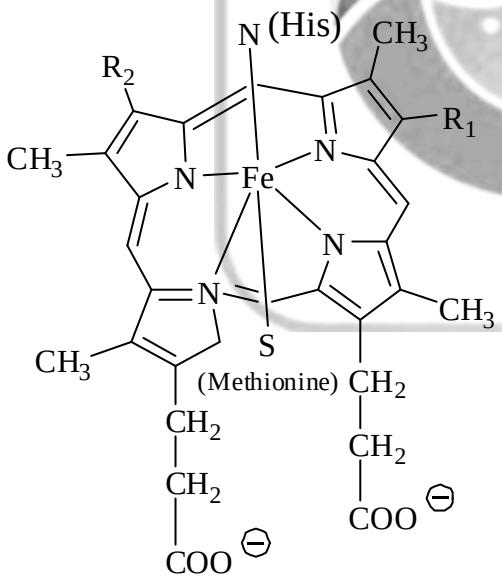
(a) $R_1 \Rightarrow CH = CH_2$
$R_2 \Rightarrow C_{18}H_{30}OH$

(b) $R_1 = R_2 = CH = CH_2$

(c) $R_1 = R_2 = CH(CH_3)S$ – Protein

(d) $R_1 = R_2 = C_{18}H_{30}OH$

7. Structure of cytochrome c (cyt c) is when R_1 and R_2 is:



(a) $R_1 \Rightarrow CH = CH_2$
$R_2 \Rightarrow C_{18}H_{30}OH$

(b) $R_1 = R_2 \Rightarrow CH = CH_2$

(c) $R_1 = R_2 \Rightarrow CH(CH_3)$ S–protein

(d) $R_1 = R_2 = C_{18}H_{30}OH$

8 The order of electron flow is:

(a) cyt b $\rightarrow$ cyt c $\rightarrow$ cyt a $\rightarrow O_2$

(b) cyt a $\rightarrow$ cyt b $\rightarrow$ cyt c $\rightarrow O_2$

(c) cyt c $\rightarrow$ cyt a $\rightarrow$ cyt b $\rightarrow O_2$

(d) cyt b $\rightarrow$ cyt c $\rightarrow$ cyt a $\rightarrow O_2$

9. Size of Bisphoglycerate is around

(a) ~ 5.0 Å (b) ~ 20 Å (c) ~ 9 Å (d) ~ 15 Å

10 Iron sulphur protein has active site

(a) Fe^{II}, Fe^{III} both (b) Fe^{II} (c) Fe^{III} (d) Fe^{IV}

11 Function of Iron-sulphur proteins

(a) electron capture (b) electron storage

(c) electron transfer (d) oxygen transfer

12 In Rubredoxin:

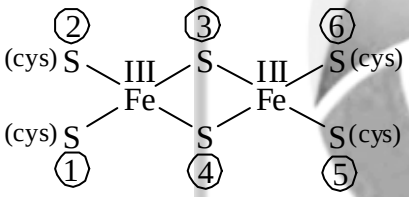
(a) All sulphurs are non-labile

(b) All sulphurs are labile

(c) only 2 sulphurs are labile

(d) only 2 sulphurs are non-labile

13. In the structure of 2Fe – 2S which sulphurs are labile



(a) S_1 and S_2 (b) S_3 and S_4 (c) S_5 and S_6 (d) S_2 and S_3

14. In oxidised form of Fe_2S_2 ferridoxin the oxidation state of Fe is:

(a) Fe^{II} both (b) Fe^{II} and Fe^{III} (c) Fe^{III} both (d) Fe^{IV} both

15. In 3Fe – 4S Ferridoxin there are

(a) 3 labile sulphur (b) 4 labile sulphur

(c) 2 non-labile sulphur (d) No labile sulphur present

ANSWERS KEY

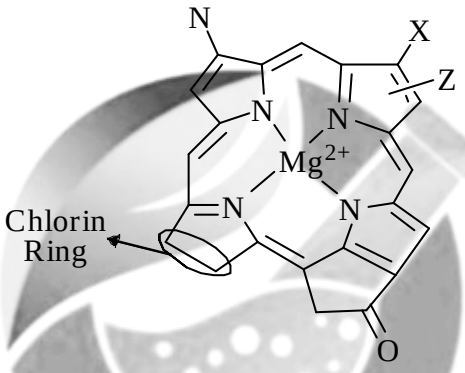
1. b	6. a	11.c
2. a	7. c	12.a
3. b	8. a	13.b
4. b	9. c	14.c
5. a	10.a	15.b

HINTS & SOLUTIONS

1.sol: $e^{\ominus}$ transfers from PSI $\rightarrow$ Ferridoxin $\rightarrow$ Ferridoxin NADP Reductase

2Sol. Porphyrin ring with one reduced double bond in chlorophyll is called chlorin ring.
Electrons are absorbed by this chlorin ring.
Option (a) is correct.

3Sol. Mg^{2+} is the active site of chlorophyll.
X = CH_3
Y = $COCH_3$
Z = Single bond



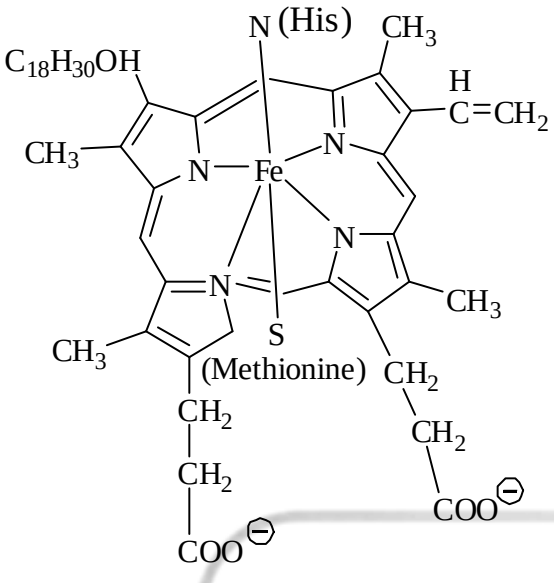
Option (b) is correct.

4Sol. Option (b) is correct.
due to intraligand $\pi - \pi^*$ charge transfer colour of chlorophyll is green

.

5.Sol. Cytochromes are heme iron proteins
Correct option is (a)

6.Sol. Cyt a or Heme a structure is



When $R_1 \Rightarrow CH = CH_2$ and $R_2 = C_{18}H_{30}OH$

7.Sol. When $R_1 = R_2 \Rightarrow CH(CH_3)S$ – protein
than it is cyt c or Heme C.

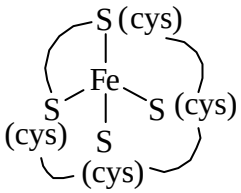
8Sol. The correct order of electron transfer is cyt b $\rightarrow$ cyt c $\rightarrow$ cyt a $\rightarrow O_2$.
As the reduction potentials for cytochromes increase in the order : cyt b (0.03 r), cyt c (0.26 v), cyt a (10.4 v)

9Sol. Option (c) is correct.
Size of biophosphoglycerate in ~ 9 Å.

10Sol. Fe^{II} and Fe^{III} both are active sites in Iron-sulphur proteins
In reduced form it exists as $\rightarrow Fe^{II}$
In oxidised form it exists as $\rightarrow Fe^{III}$

11Sol. Iron-sulphur protein function is to transfer the electron.

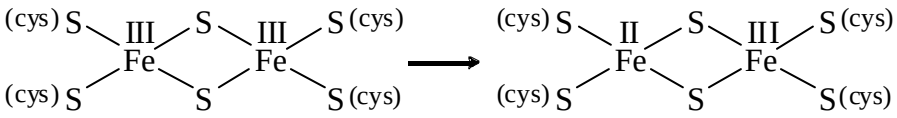
12Sol.



Correct option is (a)

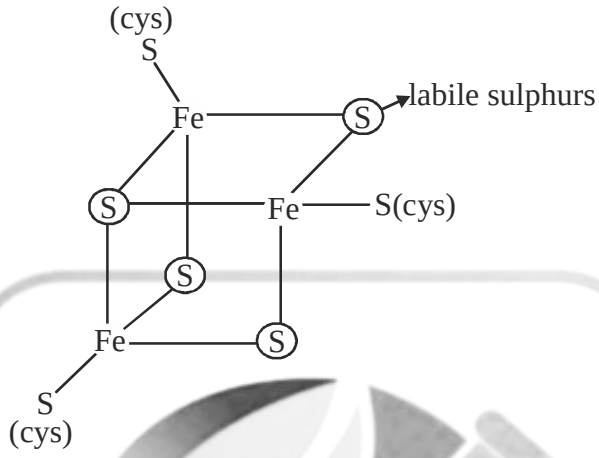
13Sol. Labile sulphur is also known as inorganic sulphur (S^{2-}), S_3 and S_4 are labile.

14Sol.



reduced form oxidised form

15Sol. In 3Fe – 4S ferridoxin. There are 4 labile sulphur (S^{2-}) and three non-labile sulphur



QUANTA CHEMISTRY

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DPP-(7) – BIOINORGANIC

1. In oxidised form 3Fe – 4S has oxidation state of :

   (a) 3Fe in +3 oxidation state (b) 2Fe in +3, 1Fe in + 2

   (c) 2Fe in + 2, 1Fe in + 3 (d) 3Fe in +2 oxidation state

2. In 4Fe – 4S Ferridoxin the oxidized form has Fe in

   (a) +3 oxidation state (b) +2 oxidation state

   (c) 2Fe in + 3, 2Fe in + 2 (d) 1Fe in + 3, 3Fe in + 2

3. Reduced form of 4Fe – 4s Ferridoxin has Fe in

   (a) + 2 oxidation state (b) + 3 oxidation state

4 The active centre of cytochrome is:

   (a) Pyrrole group (b) Chlorin group (c) Heme group (d) Corrin group

5 Porphyrin can accept two hydrogen ion to form:

   (a) +2 diacid (b) –2 dianion

   (c) +2 diacid and –2 dianion both (d) Neither diacid nor –2 dianion

6 Type of Heme group found in haemoglobin:

   (a) Heme A (b) Heme B (c) Heme C (d) All the above

7 Porphyrin can donate two hydrogen ion to form:

   (a) +2 dication (b) –2 dianion

   (c) +2 dication and –2 dianion both (d) Neither +2 dication nor –2 dianion

8 Which of the following is not a metalloporphyrin:

(a) Haemoglobin (b) Chlorophyll (c) Cytochromes (d) Hemerythrin

9 Which of the following iron-protein is not present in animals:

(a) Haemoglobin (b) Cytochromes (c) Rubredoxin (d) Myoglobin

10 Coordination of Fe atom in deoxyhaemoglobin:

(a) Octahedral (b) Square planar (c) Square pyramidal (d) Tetrahedral

11 Deoxy and oxy-haemoglobin respectively called as:

(a) Relaxed and Tensed state (b) Relaxed and Relaxed state

(c) Tensed and Tensed state (d) Tensed and Relaxed state

12 Oxidation state of iron in hematin and hematin also k/a:

(a) Fe(II) and μ-oxo dimer (b) Fe(II) and μ-peroxodimer

(c) Fe(III) and μ-oxo dimer (d) Fe(III) and μ-peroxodimer

13. Oxygen binds in myoglobin in:

(a) Peroxide form and (O_2^-) (b) Superoxide form and O_2^-

(c) Superoxid form and O_2^{2-} (d) Peroxide form and O_2^{2-}

14. Colour of blood without haemoglobin:

(a) Red colour (b) Blue colour

(c) Colourless or different colour (d) Other characteristic colour

15. Curve of Hb and Mb for partial pressure of O_2 Vs percentage saturation with O_2 respectively:

(a) Sigmoidal and Hyperbolic (b) Hyperbolic and Sigmoidal

(c) Sigmoidal for both (d) Straight line for both

ANSWERS KEY

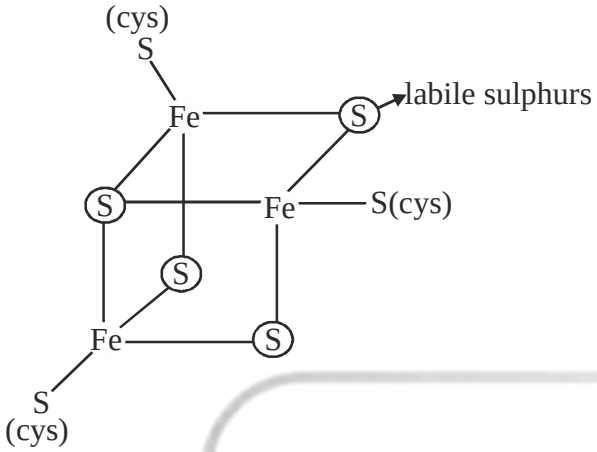
1.a	6.b	11.d
2.c	7.b	12.c
3.a	8.d	13.b
4.c	9.c	14.c
5.a	10.c	15.a

HINTS & SOLUTIONS

1Sol. The oxidised form of 3Fe – 4S

Ferridoxin has all three Fe in + 3 O.S

2Sol.

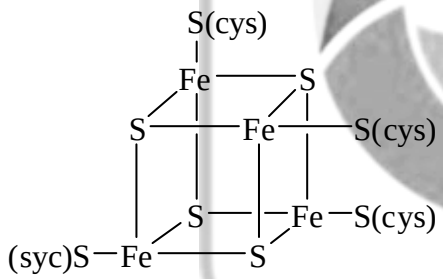


Four → Iron

Oxidized form → $2F^{III} . 2Fe^{II}$

Correct option is (c)

3Sol.



Four → Iron

Four → Labile sulphur

Four → Non-labile sulphur

QUANTA CHEMISTRY

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DPP-(8) – BIOINORGANIC

1 Oxidised and Reduced form of 2F3 – 25 ferridoxin are:

(a) diamagnetic, diamagnetic respectively (b) Pramagnetic, diamagnetic respectively

(c) diamagnetic, parmagnetic respectively (d) Pramagnetic, paramagnetic respectively

2 Superoxide dismutase contains the metal ions:

(a) Zn (II) and Ni (II) (b) Cul (II) and Zn (II) (c) Ni (II) and Co (III) (d) Cu (II) and Fe (III)

3 Geometry present along Cu^{II} and Zn^{II} in Cu – Zn Superoxide dismutase:

(a) square Pyramidal, Tetrahedral respectively (b) Tetrahedral and Square Pyramidal respectively

(c) Trigonal Bipyramidal and Tetrahedral. (d) Trigonal Bipyramidal and octahedral.

4. Cu – Zn_{SOD} and Mn_{SOD} and Fe_{SOD} is present respectively in:

(a) Humans, Bacteria (b) Fishes, Humans (c) Bacteria, Fishes (d) Both in Humans

5. In Bacterial Ruberdoxin, the number of from Atoms, sulphur Bridges and cysteine ligands are:

	Fe atom	Sulphur Bridge	Cysteine
(a)	4	4	4
(b)	2	2	4
(c)	2	2	2
(d)	1	0	4

6. Zinc metal makes the H_2O a good

(a) Acid (b) Base (c) Complex (d) Active site by loss of H^+

7. With respect to enzyme the mechanism of carbonic anhydrase enzyme is:

(a) Electrophillic addition (b) Nucleophillic addition

(c) Substitution (d) Elimination addition

8 Function of carboxy-peptidase enzyme is to do

(a) hydrolysis of peptide bond through N-terminal

(b) hydrolysis of peptide bond through C-terminal

(c) catalyse the hydration of CO_2 and dehydration of carbonic acid (H_2CO_3)

(d) catalyse the conversion of i alcohol to aldehyde.

9. Name metallo enzyme in which the transfer of hydride and loss of proton taks place:
   (a) LADH (b) Catalyse metallo enzyme
   (c) Peroxidase enzyme (d) Aldehyde oxidase enzyme

10 The extent of π-electrons conjugation in macrocyclic rings of (1) heme, (2) Coenzyme B_{12} and (3) chlorophyll follows the order.
   (a) 1 > 3 > 2 (b) 1 > 2 > 3 (c) 3 > 1 > 2 (d) 2 ≈ 1 > 3

11 The correct statement for cytochrome C is:
   (a) It is a non-heme proteins
   (b) The wordimation number of iron
   (c) It is a redox protein and and an electrons carrier
   (d) It can store or carry dioxygen.

12 Correct statement for haemoglobin are:
   (a) has molar mas is 64,500.
   (b) comprises of four myoglobin sub-units.
   (c) comprises of four myoglobin like sub-units.
   (d) None of the polypeptide chain of haemoglobin has some sequence of groups as in myoglobin.
   (i) (a), (b), (c), (d) (ii) (a), (b), (d)(iii) (a), (c), (d) (iv) (a), (d)

13 The iron core enters into the apoferritin through
   (a) 6 hydrophilic channels (b) 8 hydrophobic channels
   (c) 6 hydrophilic channels (d) 8 hydrophobic channels

14. In sodium potassium pump the movement of ions is :
   (a) $3Na^{a+}$ in, $2K^+$ out side to the cell (b) $2K^+$ in, $3Na^+$ outside the cell
   (c) $3K^+$ in, $2Na^+$ outside the cell (d) $2K^+$ out, $2Na^+$ inside the cell

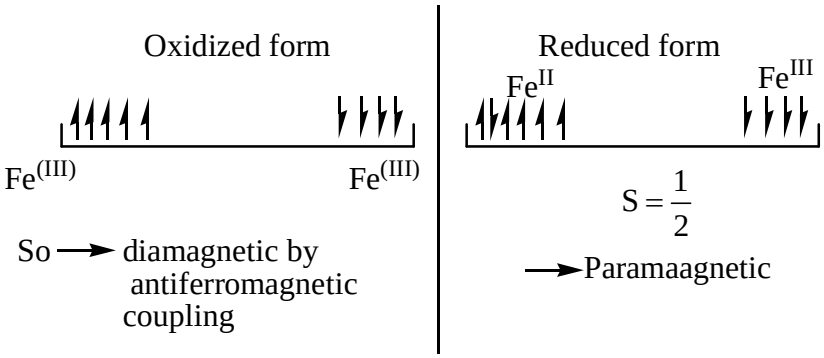
15. Which drug is best anticancer drugs :
   (a) Cisplatin (b) Diazepum (c) Gabapentin (d) Vigabatrin

ANSWERS KEY

1. c	6. b	11. c
2. b	7. b	12.c
3. a	8. b	13.c
4. a	9. a	14.b
5. d	10. a	15.a

HINTS & SOLUTIONS

1.Sol. option (c) is correct.

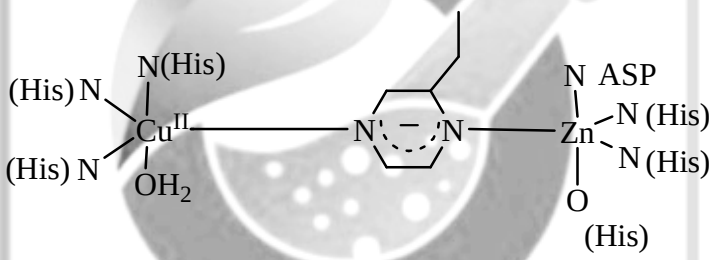


2 Sol.option (b) is correct.

$Cu^{II} – Zn^{II}$ SOD

3Sol. option (a) is correct.

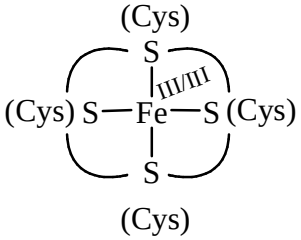
square pyramidal and Tetrahedral geometry of Cu^{III} and Zn^{II} respectively.



4Sol. option (a) is correct.

5Sol. option (d) is correct.

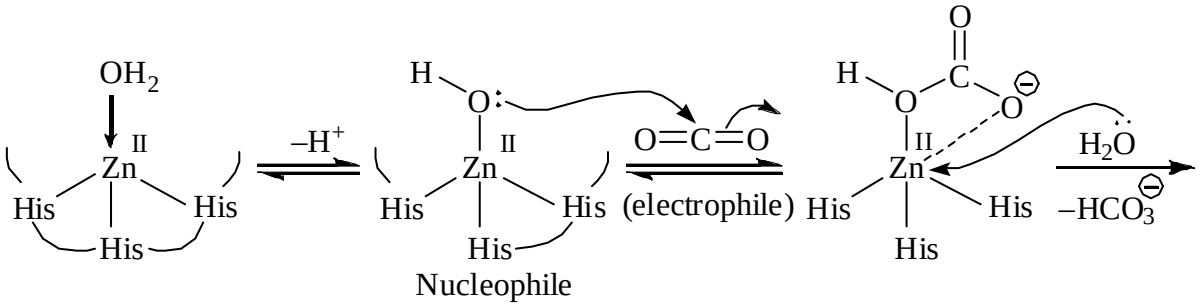
$FeS_o \rightarrow$ Fe o labile sulphur narlabice.

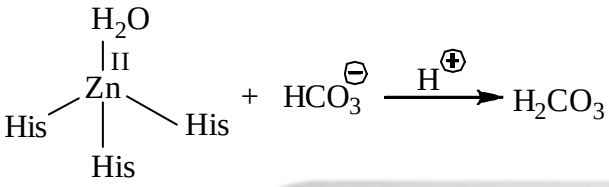


6Sol. Due to Zn(II) acidic strength of OH_2 increases

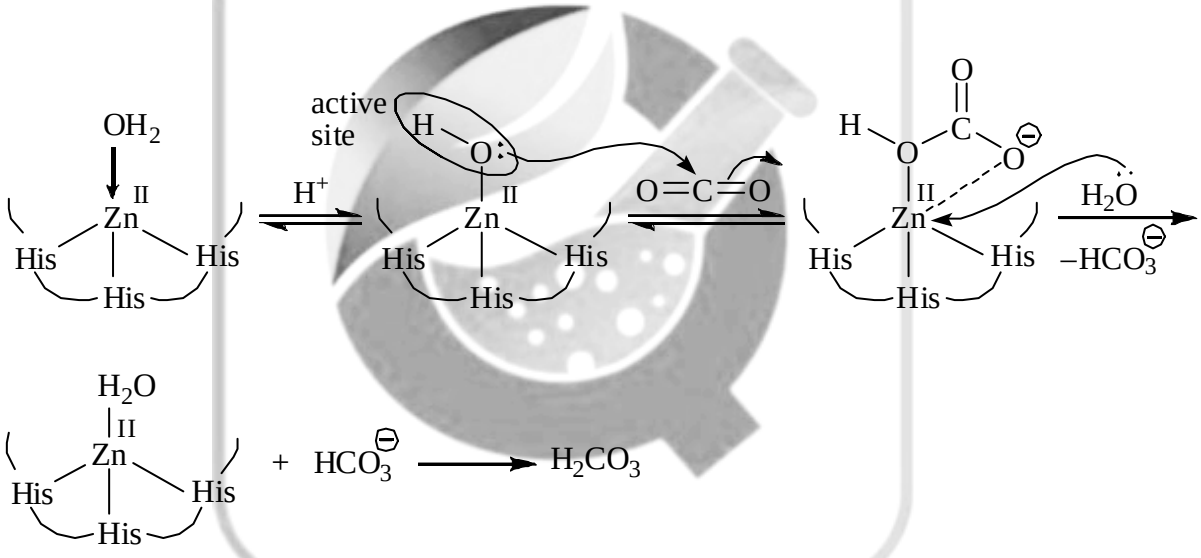
7.Sol. With respect to enzyme the mechanism of carbonic anhydrase enzyme is:

Nucleophilic addition

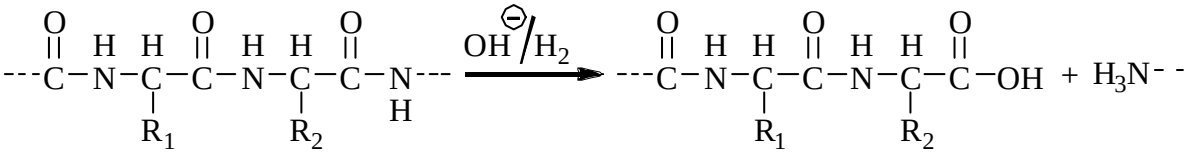




Correct option is (b)



Correct options are (a)

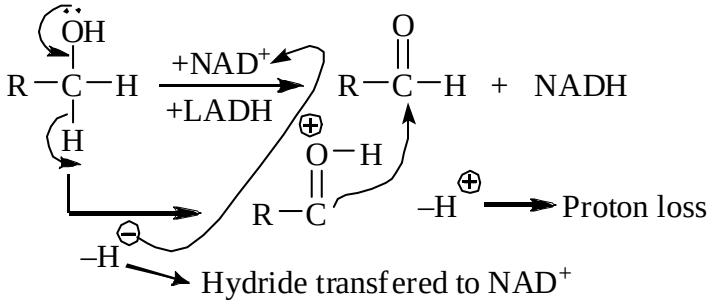
8Sol. 

$R_2 > R_1 \rightarrow$ Steric hinderance

$\therefore$ Break or cleavage from R_2 C-terminal.

Correct option is (b)

9Sol. LADH is the enzyme where transfer of hydride and loss of proton takes place



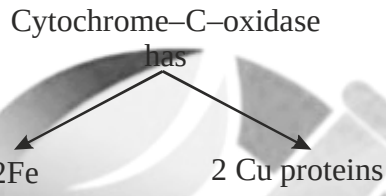
Correct option is (a)

10Sol. Conjugation order is porphyrin > chlorin > corrin

$\therefore$ Coenzyme B_{12} has $\rightarrow$ chlorin ring heme has $\rightarrow$ porphyrin ring

Correct option is (a)

11Sol. It is a redox protein and an electron carrier.



1 Fe and 1 Cu_A $\rightarrow$ involved in transfer of 1Fe and Cu_B $\rightarrow$ Reduces O_2.

Correct option is (c).

12 sol. not solution

13 Sol. $\rightarrow$ The apoferritin contains 24 protein chains each with 175 amino acids

$\rightarrow$ These 24 protein chains form a hello sphere with 100AÅ diameter

$\rightarrow$ This hollow sphere contains eight hydrophilic and six hydrophobic channels.

$\rightarrow$ The iron core enters into the apoferritin through 6 hydrophobic channels.

14Sol. The pump moves sodium and potassium ions in opposite directions, Each against its concentration gradient.

$3Na^+$ out and $2K^+$ inside the cell

Option (b) is correct.

15Sol. Cis platin is painless anticancer drug.

Option (a) is correct.

ASSIGNMENT BIOINORGATIC

MCQ (BIOINORGANIC)

1. Which enzyme convert CO_2 enters in erythrocytes to H_2CO_3:
   (a) Catalase (b) Peroxidase (c) Carbonic anhydrase (d) Carboxypeptidase

1.Ans. (c)

2. CO binding with Fe(II) centre is:
   (a) 200 times stronger than O_2 binding (b) 200 times weaker than O_2 binding
   (c) 100 times stronger than O_2 binding (d) 50 times weaker than O_2 binding

2.Ans. (a)

3. Function of Haemoglobin and Myoglobin respectively:
   (a) Both transport oxygen (b) Both store oxygen
   (c) O_2 storage and O_2 transport (d) O_2 transport and O_2 storage

3.Ans. (d)

4. Myoglobin is:
   (a) tetramer (b) trimer (c) dimer (d) monomer

4.Ans. (d)

5. Met-myoglobin and Met-haemoglobin are:
   (a) oxidised forms and do not have O_2 binding capacity.
   (b) reduced forms and do not have O_2 binding capacity.
   (c) oxidised form and have O_2 binding capacity.
   (d) reduced form and have O_2 binding capacity

5Ans. (a)

6. O_2 partial pressure for Mb in cellular tissue
   (a) low (b) high (c) moderate
   (d) can change depending open the outer environment.

6.Ans. (a)

7. Which of the following statement(s) is/are true?
   (a) In haemoglobin the coiled protein acts like spring.
   (b) Hb and mb both contains Fe in +2 state.
   (c) met-myoglobin is oxidised form of myoglobin
   (d) All the above

7.Ans. (d)

8. Upon oxygenation of myoglobin:
(a) Iron atom goes in the plane of the four porphyrin nitrogens.
(b) Coordination number of iron goes to 5.
(c) The Fe(II) is not present in plane of porphyrin ring.
(d) Molecule become paramagnetic.

8Ans. (a)

9. In oxyhaemoglobin and oxymyoglobin:
(a) Fe is in +2 oxidation state in both
(b) Fe is in +3 oxidation state in both
(c) Fe is in +3 and +2 oxidation state respectively
(d) Fe is in +2 and +3 oxidation state respectively.

9.Ans. (b)

10 Myoglobin contains
(a) two heme group
(b) mb is a tetramer having 4 heme group
(c) one heme group
(d) three heme group

10.Ans. (c)

11 O_2 binding in Hb is:
(a) pH dependent
(b) pH independent
(c) O_2 binds at neutral pH
(d) None of these

11Ans. (a)

12 Hemocyanin:
(A) has heme group
(B) found in Mollusca and Arthropoda
(C) found in mammals
(D) R/a blue blood
Correct option are:
(a) (A, B) (b) (B, C) (c) (B, D) (d) (C, D)

12.Ans. (c)

13 Examples of blue-copper protein:
(A) Stellacyanin (B) Plastocyanin (C) Azurin (D) Rubredoxin
(a) (A, D) (b) (A, B, D) (c) (A, B, C) (d) All of these

13.Ans. (c)

14 Manganese complex contains how many manganese and in which oxidation state in oxidised form?
(a) 4; 3Mn(III) and 1Mn(IV)
(b) 4; 3Mn(IV) and 1Mn(III)
(c) 2; 1Mn(III) and 1Mn(IV)
(d) 2; 1Mn(III) and 1Mn(II)

14Ans. (a)

15 What is the prosthetic group in haemoglobin?
(a) Monomer myoglobin
(b) Heme group

(c) both (a) and (b) (d) None of these

15Ans. (b)

16 Carbonic anhydrase has:

(a) 3 Histidine and 1 H_2O mol

(b) 2 Histidine, 1 Glutamine and 1 H_2O mol

(c) 1 Histidine, 1 Glutamine, 1 H_2O molecule and 1 aspartate

(d) 4 Histidine molecule

16.Ans. (a)

17 (a) Zn atom is thought to be considerably more acidic in carbonic anhydrase than in carboxypeptidase A.

(b) In atom in thought to be considerably more basic in carbonic anhydrase than in carboxypeptidase A.

(c) Both are correct.

(d) None are correct

17.Ans. (a)

18 Metal atoms present in Xanthine oxidase:

(a) 1 Zn atom (b) 2 Zn atoms (c) 1 Zn and 1 Mo atom (d) 2 Mo atoms

18.Ans. (d)

19 Electron flow in Xanthin represented as:

(a) Xanthine $\rightarrow$ Mo $\rightarrow 2Fe_2S_2 \rightarrow$ FAD $\rightarrow O_2$

(b) Xanthine $\rightarrow 2Fe_2S_2 \rightarrow$ Mo $\rightarrow$ FAD $\rightarrow O_2$

(c) Xanthine $\rightarrow$ FAD $\rightarrow$ Mo $\rightarrow 2Fe_2S_2 \rightarrow O_2$

(d) Xanthine $\rightarrow$ Mo $\rightarrow$ FAD $\rightarrow 2Fe_2S_2 \rightarrow O_2$

19Ans. (a)

20. In metallothionims:

(a) 1/3rd of amino acids are cysteine residues

(b) None of the cysteines are linked by S-S bridges

(c) There are few or no histidines

(d) All of these

20Ans. (d)

21. Certain phosphine complexes of molybdenum and tungsten containing dinitrogen readily yield ammonia in:

(a) acidic mdium (b) basic medium (c) neutral medium (d) any medium

21Ans. (a)

22. Strictly anacrobic, facultative acrobes and strict acrobes bacteria are respectively:

(a) Azotobacter vinelandii; klebsiella pneumonial and rhizobium

(b) Glostridium pasteurianum, klebsiella pneumonial and azotobacter vinelandii

(c) Klebsiella pneumonial, clostridium pasteurianum and azotobacter vinerlandii

(d) Clostridium pasteurianum, azotobacter vinelandii and klebsiella pneumonial

22Ans. (b)

23. Transferrins of higher animals have:

(a) Larger stability constants towards iron(III)

(b) Antibacterial agents

(c) Both correct (a) and (b)

(d) Both incorrect (a) and (b)

23.Ans. (c)

24. The core of ferritin has:

(A) 8 hydrophilic channels (B) six hydrophobic channels

(C) 8 hydrophobic channels (D) six hydrophilic channels

(a) A, B (b) C, D (c) A, C (d) B, D

24Ans. (a)

25. The major component of bone tissue in the vertebrate skeleton is; $Ca_5(PO_4)_3$ X where X is

(a) OH (b) NH_3 (c) Cl (d) Br

25Ans. (a)

26. Which of antibiotics do not have chelating properties?

(a) Streptomycin (b) Usnic acid (c) Aspergillic acid (d) None

26Ans. (d)

27. Valinomycin:

(a) Known as ionophore antibiotics

(b) Resemble the crown ether and cryptates

(c) Are useless in humans because they are toxic to mammalian cells

(d) All of these

27Ans. (d)

28. Conversion of nitrogen (N_2) to NH_3 is called.

(a) Nitrogen fixation (b) Nitrification

(c) denitrification (d) Ammonification

28Ans. a

28Sol. Nitrogen fixation

Correct option is (a)

29. Two methods for nitrogen fixation are:

(a) Haber process and biological process (b) Nitrification and Ammonification

(c) Anammox and nitrification (d) Haber process and nitrification

29Ans. a

29Sol. Haber process and Biological process.

30 The bond dissociation energy of N_2 is

(a) 945 KJ/mol (b) 1100 KJ/mol (c) 450 KJ/mol (d) 1500 KJ/mol

30 (a)

30Sol. The bond dissociation energy of N ≡ N is 949 KJ/mol.

Option (a) is correct.

31 Haber process is :

(a) in vivo (b) in vitro (c) Both (d) None

31. (a)

31Sol. Haber process is in vitro process (outside the biological systems).

Option (a) is correct.

32 Function of transferrin is

(a) Iron storage in bone marrow

(b) Iron transport from stomach to bone marrow and delivers to Ferritin

(c) Iron storage in liver

(d) electron transfer

32. (b)

32.Sol. Option (b) is correct.

33 Life of Hemoglobin is

(a) 4 weeks (b) 8 weeks (c) 16 weeks (d) 20 weeks

33. (c)

33Sol. Life of Hemoglobin is (16 weeks)

Option (c) is correct.

34. Excess uric acid causes

(a) Wilson's disease (b) Arthritis (c) Gout (d) Cancer

34 (c)

34Sol. Excess of uric acid causes Gout.

Option (c) is correct.

35. Active site in Urease is :

(a) Ni^{2+} (b) Cu^{2+} (c) Fe^{2+} (d) Zn^{2+}

35. (a)

35Sol. Active site in urease is Ni^{2+}.

Option (a) is correct.

36. Function of urease is to

(a) Oxidise xanthine (b) Catalyse the hydrolysis of urea

(c) Used in chelate therapy (d) None

36. (b)

$$H_2NCONH_2 + H_2O \xrightarrow{\text{urease}} \underset{\text{(Carbonic acid)}}{H_2NCOOH} + NH_3$$

36Sol. or

$$\underset{\text{(Carbamate)}}{H_2NCOO^{\ominus}} + NH^4$$

Carbamic acid is further hydrolysed to give carbonic acid (H_2CO_3)

$$H_2NCOOH + H_2O \xrightarrow{\text{urease}} \underset{\text{(Carbonic acid)}}{H_2CO_3} + NH_3$$

Option (b) is correct.

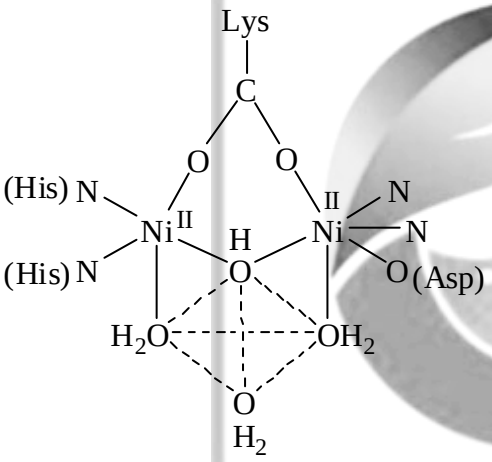
37. How many Ni^{2+} sites are present in urease :

(a) 2 (b) 1

(c) 3 (d) One Ni^{2+} one Ni^{+}

37. (b)

37Sol.



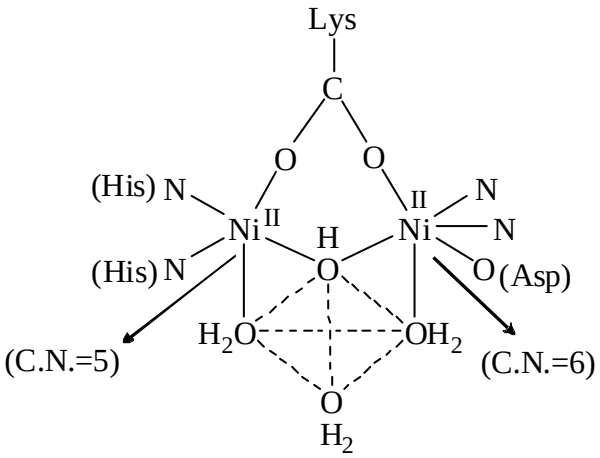
Option (b) is correct.

38. The coordination no. of Ni^{2+} in urease is :

(a) 5 both (b) 6 both (c) 6 and 5 (d) 4 and 5

38. (c)

38Sol. Coordination no. of one Ni^{2+} is 5 and other has 6.



Option (c) is correct.

39. Wilson's disease is caused due to :

(a) Overload/excess of platin (b) Overload/excess of copper

(c) Excess of ceruloplasmin (d) None

39. (b)

39Sol. Option (b) is correct.

40. Spontaneous flow of solute particle from _____ concentration to _____ concentration is called diffusion.

(a) low, high (b) high, high (c) low, low (d) high, low

40. (d)

40Sol. Option (d) is correct.

41. The energy in sodium potassium pump is obtained from

(a) flow of solute (b) Movement of ions (c) hydrolysis of ATP (d) None

41 (c)

41Sol. Option (c) is correct.

42. Treatment of arthritis through :

(a) Gold drugs (b) copper drugs (c) Platin (d) Chelate therapy

42. (a)

42.Sol. Option (a) is correct.

43. The chemical shift value (δ) of $\boxed{N-H}$ in porphin molecule is :

(a) 8.0 ppm (b) 4.1 ppm (c) –2 to –3 ppm (d) 6.0 ppm

43. (c)

43Sol. $\rightarrow$ Highly shielded proton are the protons of $\boxed{N-H}$ in porphin molecule.

→ Hence their chemical shift value (δ) is –2 to –3 ppm.

Option (c) is correct.

44. The protons of N – H in porphin are :

(a) shielded (b) deshielded

(c) Nitrogen don't have hydrogen (d) one is shielded other is deshielded

44. (c)

44.Sol. The 2NH protons of porphin molecule are highly shielded.

Option (c) is correct.

45 The chemical shift value of meso prorons in porphyrin is

(a) 8.0 ppm (b) – 2 to –3 ppm (c) 6.0 ppm (d) 4.1 ppm

45. (d)

45Sol. Meso protons are deshielded protons. Hence 4.1 ppm is the chemical shift value.

Option (d) is correct.

46 The β–H (β-protons) of porphyrin ring has the chemical shift value of

(a) 8.0 ppm (b) –2 to –3 ppm (c) 6.0 ppm (d) 4.1 ppm

46. (a)

46Sol. 8.0 ppm is the value of chemical shift of β-protons in porphyrin ring as they are highly dishielded protons.

Option (a) is correct.

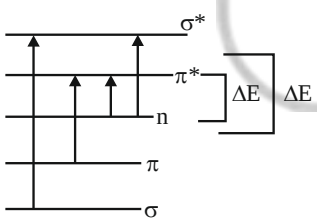
47 Types of transitions possible in porphyrin ring :

(a) $\sigma - \sigma^*$ transition, $n - \pi^*$ transition (b) $\pi - \pi^*$ transition, $n - \pi^*$ transition

(c) $\sigma - \sigma^*$ transition, $\pi - \pi^*$ transition (d) $n - \sigma^*$ transition, $\pi - \pi^*$ transition

47. (b)

47Sol. $\pi - \pi^*$ transition and $n - \pi^*$ transition



$\because$ Lone pairs are present, therefore $n \rightarrow \pi^*$ and

π – bonds present.

$\therefore$ $\pi - \pi^*$ transitions.

Option (b) is correct.

48 Porphin Ring is deeply coloured due to :

(a) intraligend $\pi - \pi^*$ transition (b) $n \rightarrow \pi^*$ transition

(c) d – d transition (d) LMCT

48. (a)

48.Sol. Porphin ring is deeply coloured due to intraligand $\pi - \pi^*$ transition.

Option (a) is correct.

49 Porphyrin ring is :

(a) Non-rigid (b) Rigid (c) Non-planar (d) Octahedral

49. (b)

49Sol. Porphyrin Ring is planar due to delocalisation.

Option (b) is correct.

50 Stability of Metalloporphyrin complex.

(a) $Ni^{2+} > Cu^{+2} > Zn^{+2} > > Fe^{+2} > Co^{+2}$ (b) $Ni^{2+} > Zn^{+2} > Co^{+2} > Fe^{+2} > Cu^{+2}$

(c) $Ni^{+2} > Cu^{+2} > Co^{+2} > Fe^{+2} > Zn^{+2}$ (d) $Ni^{2+} > Fe^{+2} > Zn^{+2} > Cu^{+2} > Co^{+2}$

50. (c)

50Sol. Due to size the stability of metalloporphyrin complex is :

$Ni^{2+} > Cu^{+2} > Co^{+2} > Fe^{+2} > Zn^{+2}$

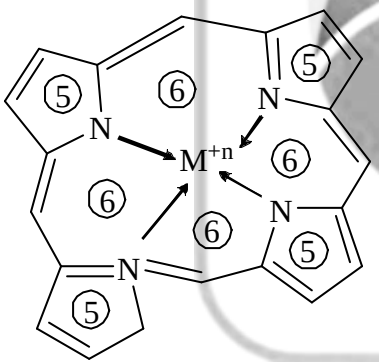
Option (c) is correct.

51 How many (5) and (6) membered rings are present in Metalloporphyrin respectively :

(a) 4, 5 (b) 5, 4 (c) 4, 4 (d) 4, 6

51. (c)

51Sol.



→ four 6-membered rings

→ four 5-membered rings

Option (c) is correct.

52 No. of signal in metalloporphyrin ring in ^1H NMR :

(a) 2 (b) 3 (c) 8 (d) 10

52. (a)

52.Sol. $\left.\begin{array}{l} 8\ \beta \text{ protons} \rightarrow 1 \text{ signal} \\ 4 \text{ meso protons} \rightarrow 1 \text{signal} \end{array}\right]$ Total 2 signals.

Option (a) is correct.

53 Myoglobin is present in :

(a) Tissue (b) Liver (c) Bones (d) Lungs

53. (a)

53.Sol. Mb is present in tissue.

Option (a) is correct.

54. Cn, Co, No has more binding affinity towards Fe^{2+} in Mb. Why only O_2 binds ?

(a) due to electronegativity factor

(b) due to bent binding which provides hydrogen bonding with distal protein

(c) due to linear binding of O_2

(d) due to sp^2 hybridised oxygen.

54. (b)

54Sol. Oxygen binds in bent form which provides H-bonds with distal protein while (N, No, Co) binds linearly avoiding H-bonding.

Option (b) is correct.

55 Deoxy myoglobin is :

(a) Paramagnetic (b) Diamagnetic (c) ESR inactive (d) Low spin metal binding

55. (a)

55Sol. Deoxy myoglobin has Fe^{+2} in high spin which makes it paramagnetic and ESR active.

Option (a) is correct.

56 The ν_{0-0} frequency in oxymyoglobin is :

(a) ~ 1100 cm^{-1} (b) ~ 1560 cm^{-1} (c) ~ 800 cm^{-1} (d) ~ 1800 cm^{-1}

56. (a)

56Sol. Oxygen binds as super oxide $(O_2^{\ominus})$ and it ν_{0-0} frequency is $\rightarrow$ ~ 1100 cm^{-1}.

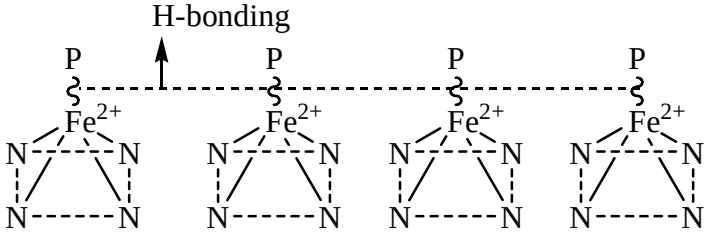
Option (a) is correct.

57 The salt bridges in hemoglobin are formed due to:

(a) H-bonding (b) Ionic bonding (c) Covalent bonding (d) Diple integrations

57. (a)

57Sol. Option (a) is correct.



The bonding takes place due to electrostatic interaction between NH_3^+ and coo^- in globin chain.

58 Oxygen in linear form will not allow

(a) Low sping complex (b) H-bonding with distal protein

(c) Globin chain interactions (d) Fe in high spin.

58. (b)

58Sol. Option (b) is correct.

If oxygen binds linearly them H-bonding with distal protein is not possible.

59 Increasing order of rate according to cooperativity effect is:

$Hb + O_2 \xrightarrow{K_1} HbO_2$

$HbO_2 + O_2 \xrightarrow{K_2} Hb(O_2)_2$

$Hb(O_2) + O_2 \xrightarrow{K_3} Hb(O_2)_3$

$Hb(O_2)_3 + O_2 \xrightarrow{K_4} Hb(O_2)_4$

(a) $K_1 > K_2 > K_3 > K_4$ (b) $K_4 > K_2 > K_3 > K_1$

(c) $K_1 > K_3 > K_4 > K_2$ (d) $K_4 > K_3 > K_2 > K_1$

59. (d)

59.Sol. Option (d) is correct.

The increasing rate of O_2 binding according to cooperativityy effect is $K_4 > K_3 > K_2 > K_1$.

60 Enzyme which catalyse PrFe(III)–pt_2O to PrFe(II)–O=O is

(a) Met Hb Reductase (b) Carboxy Anhydrase

(c) Carboxy Peptidase (d) Metalloenzyme

60. (a)

60Sol. Option (a) is correct.

Met Hb Reductase Enzyme Catalyse BFe(III)–H_2O to PrFe(II)–O=O.

61 According to Bohr effect if concentration of H^+ increases:

(a) pH will also increase (b) pH will decrease

(c) pH remains unaffected (d) first increases than decreases.

61. (a)

61.Sol. Option (a) is correct.

pH will decrease with increase in H^+ concentration.

$\therefore \quad pH = -\log[H^+]$

$\therefore \quad pH \propto \frac{1}{[H^+]}.$

62. According to Bohr effect with increase in concentration of CO_2 binding capacity of O_2 in Hb

(a) decreases as pH decreases (b) increases as pH decreases

(c) decreases as pH increases (d) increases as H^+ increases.

62. (a)

62.Sol. Option (a) is correct.

Binding capacity of $O_2 \propto$ pH in Hb.

63. Binding capacity of O_2 in Myoglobin

(a) decreases with decrease in pH (b) increases with increase in pH

(c) independent of pH (d) None

63. (c)

63.Sol. Option (c) is correct.

Binding capacity of O_2 in Mb is independent of pH.

64 BPG (Biophosphoglycerate) has tendency to make

(a) deoxyhemoglobin (b) oxyhemoglobin (c) Hemerythrin (d) Hematin

64. (a)

64Sol. Option (a) is correct.

Biophosphoglycerate removes oxygen to fit itself in the cavity. Hence makes deoxyhemoglobin.

65 In lungs oxyhemoglobin formation is supported due to

(a) low pressure (b) Hb releases H^+

(c) H^+ bind HCO_3^- and releax CO_2 (d) High pressure.

65. (d)

65.Sol. Option (d) is correct.

In lungs the pressure is high, hence O_2 binding increases. Hence oxyhemoglobin forms.

66 Bisphosphoglycerate BPG effect the O_2 binding in lungs:

(a) increases O_2-binding in BPG increases (b) decreases O_2 binding if BPG decreases

(c) no effect on O_2 binding (d) increases O_2 binding if BPG decreases.

66. (c)

66Sol. Option (c) is correct.

As in lungs the pressure is high. Hence, O_2 binding increases and results in increase in oxyhemoglobin production.

Increasing BPG, increases-deoxyhemoglobin.

Both cancels each other and hence no effect of BPG on O_2 binding capacity in lungs.

67 In tissues if bisphosphoglycerate concentration increases

(a) It will increase deoxyform formation (b) It will decrease deoxy form formation

(c) It will not affect O_2 binding (d) None.

67. (a)

67Sol. Option (a) is correct.

In tissues the pressure is not high. Hence bisphosphoglycerate will stablise deoxy form more.

68 Binding capacity of O_2 is in hemoglobin _____

(a) directly proportional to pH (b) inversely proportional to pH

(c) directly proportional to H^+ concentration (d) do not depend on pH

68. (a)

68Sol. Option (a) is correct.

pH $\propto$ binding capacity of O_2 in Hb.

69 Mb stores O_2 in:

(a) Muslce tissues (b) Venus blood (c) Cells (d) Arterial blood

69. (a)

69.Sol. Option (a) is correct.

Mb stores O_2 in muscle tissues and releases when required (during activity for decomposition of glucose).

Assignment-9

Bioinorganic

70 The active sites of Blue copper proteins are:

(a) Cu^{+} (b) Cu^{+2} (c) Cu^{o} (d) only (b) and (c)

70. (b)

70Sol. option (a) and (b) are correct.

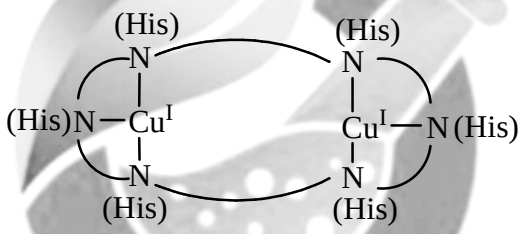
Active site of copper in reduced form is Cu^{+} and in oxidised form is Cu^{+2}

71 The active site of Type-3 copper proteins is:

(a) Cu^{I} (b) Cu^{II} (c) Fe^{I}, Cu^{I} (d) Fe^{II}, Cu^{II}

71 (b)

71Sol. The active site of Type-3 (Hemocyanin) copper protein is: Cu^{I}



72 Oxyhemerythrin has voilet colour due to

(a) MLCT (b) $\pi - \pi^*$ transitions (c) LMCT (d) d-d transitions

72 (c)

72Sol. option (c) is cottect.

Oxyhemerythrin has violet colour due to LMCT.

73 In deoxyhemerythrin the colour is?

(a) Colourless (b) Blue (c) Violet (d) Red

73. (a)

73Sol. option (a) is correct.

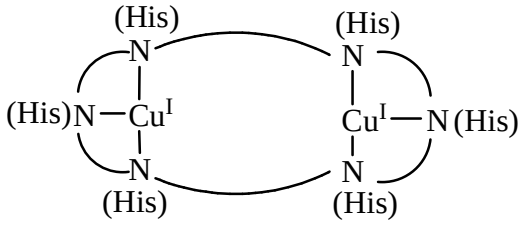
The colour of deoxyhemerythrin is colour less.

74 No. of N (this) present in Hemocyanin

(a) 7 (b) 8 (c) 4 (d) 6

74. (d)

74Sol. option (d) is correct.



75 The transfer of charge in Hemocyanin takes place as

(a) Cu^{2+} to O_2^{2+} (b) O_2^{2-} to Cu^{2+} (c) N (this) to Cu^{2+} (d) Cu^{2+} to this

75 (b)

75Sol. option (b) is correct.

This Ligand to metal charge transfer takes place in orghemocyanin due to which blue colour axises.

The transfer takes place from O_2^{2-} to Cu^{2+}.

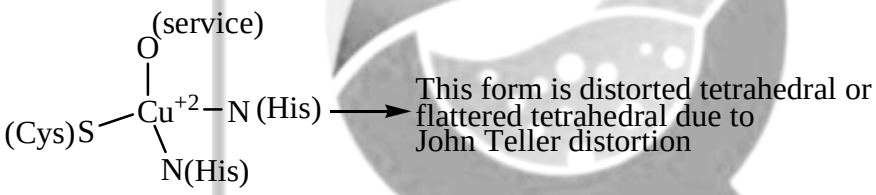
76 Stellacyanin is an:

(a) e^{Θ} tansfer protein (b) O_2 transfer protein (c) Metal transfer protein (d) O_2 stronge protein

76 (a)

76Sol. option (a) is correct.

Stellacyanin in an e^{Θ} transfer protein.



77 The e^{Θ} transfer in Stellacyanin takes place from:

(a) O of series to Cu^{2+} (b) N of the to Cu^{2+}

(c) S of Cystein to Cu^{2+} (d) Both (a) and (b)

77. (c)

77.Sol. option (c) is correct.

The e^{Θ} transfer in stellacyanin takes place from S of cystein to Cu^{2+}.

78 In Cu–Zn Superoxide Dismutase

(a) Cu^{2+} is replacable (b) Zn^{2+} Zn^{2+} replacable

(c) None can be replaced (d) Both are replacable.

78. (b)

78.Sol. option (b) is correct.

only Zn^{2+} is replacable in Cu–Zn SOD by cobalt or cadmium.

Cu^{2+} can't be replaced, it is essential.

79 Fe exist in which geometry in Fe–S Protein.

(a) Octahedral (b) Square Pyramidal (c) Tetrahedral (d) Trigonal Bipyrmidal

79 (c)

79Sol. option (c) is correct.

Fe exists in Tetrahedral geometry in Iron-sulphur proteins.

---

80 Labile sulphurs are:

(a) Acidic and present in M–S–M from (M = metal)

(b) Non-acidic and present in S-cystein form

(c) Organic sulphurs containing proteins

(d) Both (a) and (c)

80. (a)

80Sol. option (a) is correct.

Labile sulphurs are Acidic present in the form M–S–M where (M = metal)

81. Function of peroxidase enzyme is to

(a) Convert primary alcohol to aldehyde

(b) Convert secondary alcohol to ketone

(c) Catalyse the oxidation of any compound in presence of H_2O_2

(d) Dissociation of O_2

---

81. (c)

81Sol. $PrFe(III) \xrightarrow{H_2O_2} PrFe(IV) = O \xrightarrow{AH_2} A + PrFe(III) + H_2O$

$\Downarrow$

$[H_2O] + [O]$

It catalyse the oxidation of any compound in presence of H_2O_2.

Correct option is (c)

82 Electron transfer in cytochromes is:

(a) Cyt b $\rightarrow$ Cyt a $\rightarrow$ Cyt c $\rightarrow O_2$ (b) Cyt b $\rightarrow$ Cyt c $\rightarrow$ Cyt a $\rightarrow O_2$

(c) Cyt a $\rightarrow$ Cyt c $\rightarrow$ Cyt b $\rightarrow O_2$ (d) Cyt c $\rightarrow$ Cyt b $\rightarrow$ Cyt a $\rightarrow O_2$

82.Ans. (b)

82.Sol. $e^{\ominus}$ transfer order takes place as

Cyt b $\rightarrow$ Cyt c $\rightarrow$ Cyt a $\rightarrow O_2$

83. Which protein will oxidize Fe^{2+} to Fe^{3+} so that it can bind to transferrin?

(a) Ceruloplasmin (b) Cytoplasm (c) Chlorophyll (d) Cytochromes

83.Ans. (a)

83.Sol. $\rightarrow$ Ceruloplasmin (Multicopper protein), oxidize Fe^{2+} to Fe^{3+}

$\rightarrow$ The Fe^{3+} binds to transferrin and transferrin transport Fe^{3+} bone marrow through blood stream.

84. Fe^{2+} oxidized to Fe^{3+} in bone marrow by:

(a) ferroxidase (b) ceruloplasmin (c) cytochromes (d) chlorophylls

84.Ans. Option (a) is correct.

84Sol. Ferroxidase oxidizes Fe^{2+} to Fe^{3+} in bone marrow and then Fe^{3+} binds ferritin.

85. Fe is stored in animals by

(a) Ferritin (b) Transferrin (c) Hemosiderin (d) Siderophore

85.Ans. Option (c) is correct.

86. Fe is stored in bacteria by

(a) Ferritin (b) Transferrin (c) Hemosiderin (d) Siderophore

86.Ans. Option (d) is correct.

87. Fe is stored in humans by:

(a) Perritin (b) Transferrin (c) Hemosiderin (d) Siderophore

87.Ans. Option (a) is correct.

88. Full form of ATP is:

(a) Adenosine Triphosphate (b) Adenosine Tetraphosphate

(c) Argenine Triphosphate (d) Argenine Tetraphosphate

88.Ans. Option (a) is corret.

89. Photosystems aer:

(a) Chloroplasts (b) Antenna molecules

(c) Cluster of chlorophylls in pigment protein complexes from

(d) cytochrome

89Ans. Option (c) is correct.

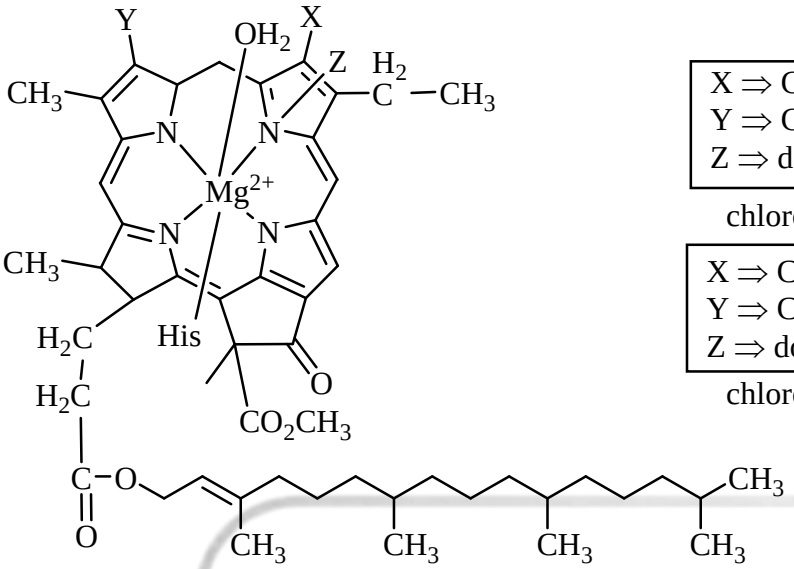
89Sol. Chlorophylls (antenna molecules) are clustered together in pigment protein complexes called photo-systems.

90.. Chlorophyll contains which metal ion:

(a) Ca^{2+} (b) Mg^{2+} (c) Co^{III} (d) Cu^{2+}

90.Ans. Option (b) is correct.

90Sol.



X ⇒ CHO
Y ⇒ $CH_2 = CH_2$
Z ⇒ double bond

chlorophyll-(b)

X ⇒ CH_3
Y ⇒ $CH_2 = CH_2$
Z ⇒ double bond

chlorophyll-(a)

91. Bacteriochlorophyll is when

(a) X ⇒ CH_3, Y ⇒ $CH_2 = CH_2$, Z ⇒ double bond

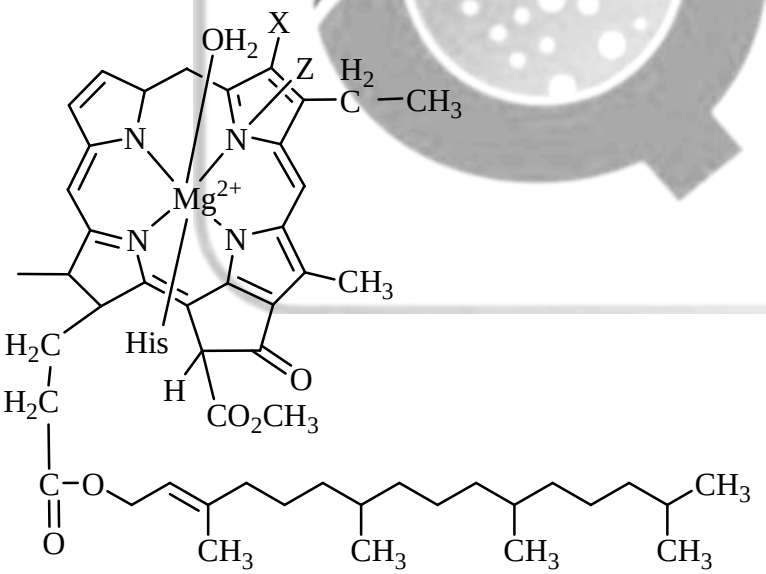
(b) X ⇒ CHO, Y ⇒ $CH_2 = CH_2$, Z ⇒ double bond

(c) X ⇒ CH_3, Y ⇒ $COCH_3$, Z ⇒ single bond

(d) X ⇒ CHO, Y ⇒ $COCH_3$, Z ⇒ double bond

91. (c)

91.Sol.



Option (c) is correct.

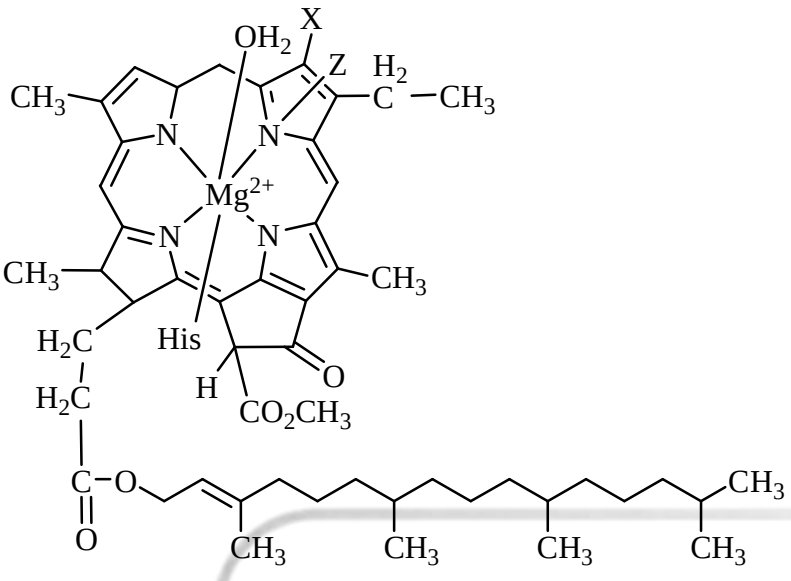
92. In chlorophylls the ring present is:

(a) Porphyrin ring (b) Corrin ring

(c) Pyrrole (d) Chlorine

92.Ans. Option (d) is correct.

92.Sol.



93. Total no. of double bonds present in chlorophyll ring.

(a) 11 (b) 9 (c) 12 (d) 10

93.Ans. (d)

93.Sol. One bond reduced from porphyrin hence called chlorine ring.

$\therefore$ Total $\rightarrow$ 10 ring.

94. In bacterial synthesis the product obtained are :

(a) carbohydrates, sulphur, water (b) carbohydrates, oxygen, water

(c) carbohydrates, nitrogen, water (d) carbohydrates, carbon dioxide, water

94Ans. (c)

94Sol. $CO_2 + 2H_2S + h\nu \rightarrow CH_2O + 2S + H_2O$

95 The flow of e^{Θ} in photosynthesis is:

(a) Php $\rightarrow$ Pcy $\rightarrow$ Rieske center $\rightarrow$ Q $\rightarrow$ Cyt b $\rightarrow$ Cyt bf

(b) Rieske center $\rightarrow$ Pcy $\rightarrow$ Php $\rightarrow$ Cyt b $\rightarrow$ Cyt bf

(c) Php $\rightarrow$ Cyt b $\rightarrow$ Q $\rightarrow$ Rieske center $\rightarrow$ Cyt bf $\rightarrow$ Pcy

(d) Pcy $\rightarrow$ Php $\rightarrow$ Cyt b $\rightarrow$ Q $\rightarrow$ Cyt bf $\rightarrow$ Rieske center

95.Ans. (c)

Flow of e^{Θ} is

95.Sol. From $P_{680} \rightarrow$ Phy $\rightarrow$ Cyt b $\rightarrow$ Q $\rightarrow$ Rieske centre $\rightarrow$ Pcy $\rightarrow$ Cyt bf

Since one is R, R and the other is S, S.

96. Ps^{+}_{680} and Ps^{+}_{700} are reduced by

(a) cytochromes (b) Tyrosine (c) NAD^{+} (d) Ferredoxin

96.Ans. (b)

96.Sol. Tyrosine reduces Ps^{+}_{680} and Ps^{+}_{700} to Ps_{680} and Ps_{700}

97 The catalyst involved in haber process in nitrogen fixation are:

(a) Fe/Mo (b) Zn (c) Co/Fe (d) Cu

97Ans. (a)

97Sol. The catalyst involved are Fe/Mo catalyst.

Correct option is (a)

98 The two intermediates during conversion of N_2 to NH_3 are highly disfavoured:

(a) Kinetically due to higher energies than either of the reactants or products.

(b) Thermodynamically dueto higher energies than reactant or product

(c) Kinetically due to lower energy

(d) Thermodynamically due to lower energy.

98Ans. (b)

98Sol. The two intermediates before N ≡ N bond breaking completely, HN = NH (diazene) and $H_2N–NH_2$ (hydralazine) are disfavoured thermodynamically because they have higher energies than either of the reactants or products.

Correct option is (b)

99. The presence of which metal is mercury component of most nitrogen.

(a) Fe (b) Cu (c) Mo (d) Zn

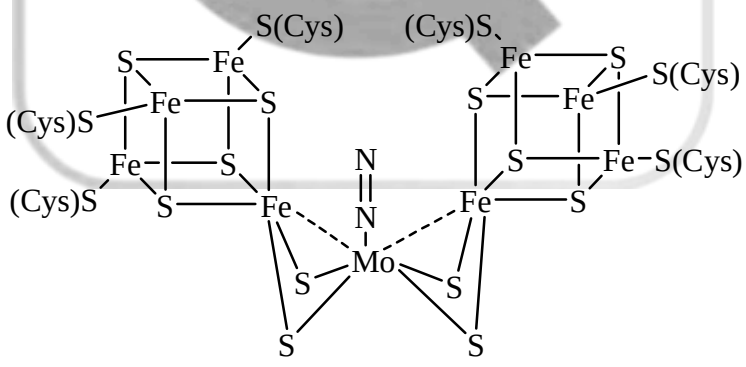
99.Ans. (c)

99Sol. Mo

Correct option is (c)

100. The Fe protein (called the P-cluster) has _____ Fe_4S_4 units in Mo–Fe protein.

100Sol. 2 Fe_4S_4 units.



Structure of the active site of the Mo–Fe protein nitrogenase.

101 Number of protons and electrons involved in the enzyme nitrogenase reaction are

(a) $4H^+$ and $4e^\ominus$ (b) $8H^+$ and $8e^\ominus$ (c) $6H^+$ and $8e^\ominus$ (d) $8H^+$ and $6e^\ominus$

101Ans. (b)

101Sol. $N_2 + 16\ mg.ATP + 8H^+ + 8e^\ominus \longrightarrow 2NH_3 + 16\ mg\ ADP + 16\pi + H_2$

where π is in organic phosphorus

Correct option is (b)

102 The energy for the movement of solute particles through cell membrane from low concentration to high concentration obtain energy from:

(a) Hydrolysis of ATP (b) Na^+ and K^+ movement

(c) Water soluble substances (d) ADP hydrolysis

102Ans. (a)

102Sol. The energy is obtained from the hydrolysis in ATP. This is called as active membrane transport.

Correct option is (a)

103 How many K^+ goes and Na^+ inside in sodium potassium pump:

(a) $2K^+, 3Na^+$ (b) $1K^+, 1\ Na^+$ (c) $3K^+, 2Na^+$ (d) $3Na^+, 3K^+$

103. (c)

103Sol. $3Na^+$ (in) + $2K^+$ (out) + ATP + $H_2O \longrightarrow 3Na^+$ (out) + $2K^+$ (in) + ADP + π

104 Cisplatin has negative side effect in kidney and neuro-toxicity, therefore, it is replaced by

(a) Other zinc complexes (b) Cu complexes

(c) Other platin complexes (d) Cobalt complexes

104 (c)

104Sol. Cis platin replaced by other platin complexes like carboplatin and oxaliplatin

105 Complexes of which metal have been used most successfully for the treatment of antibiotic diseases in humans.

(a) Mo (b) Pt (c) Au (d) Cu

105Ans. (c)

106 High does of dietary supplement $ZnSO_4$ for the case of Zn deficiency:

(a) Reduces myoglobin (b) Increases iron level in blood

(c) Increases copper level in brain (d) Reduces copper, iron and calcium levels in body.

106Ans. (c)

107 $Hb + O_2 \underset{}{\overset{K_1}{\rightleftharpoons}} HbO_2$

$HbO_2 + O_2 \overset{K_2}{\rightleftharpoons} Hb(O_2)_2$

$Hb(O_2)_2 + \overset{K_3}{\rightleftharpoons} Hb(O_2)_3$

$Hb(O_2)_3 + O_2 \overset{K_4}{\rightleftharpoons} Hb(O_2)_4$

Which is the correct option regarding above reaction?

(a) $K_4 > K_3 > K_1 > K_1$ K/a cooperatively effect

(b) $K_4 > K_2 > K_3 > K_1$ K/a Bohr's effect

(c) $K_4 > K_1 > K_2 > K_3$ K/a catalystic effect

(d) $K_4 > K_3 > K_2 > K_1$ K/a trigger mechanism.

107Ans.(d)

108 Which of the following is not a copper containing metallo-enzyme?

(a) Txyrosinane (b) Cytochrome oxidase

(c) Phosphohydrolases (d) Ascorbate oxide

108 Ans.(c)

109 Magnesium and Manganese containing metallo-enzymes are respectively:

(a) Phosphohydrolases and Arginase.

(b) Arginase and oxaloacetate decarboxylase.

(c) Galactose oxidase and phosphohydrolases.

(d) Phosphotransferases and oxaloacetate decarboxylase.

(i) (a), (b), (c) (ii) (a), (c), (d) (iii) (a), (d) (iv) All of these.

109 Ans.(iii)

110 In carbonic anhydrase Zn metal is coordinates with:

(a) Two imidazole of histidine, 1 glutamic acid and H_2O molecule.

(b) Three imidazole of histidine and the molecule.

(c) Two imidazole of histidine, 1 cysteine and H_2O molecule.

(d) Two cysteine, 1 histidine and H_2O molecule.

110Ans(b)

111 In carboxypeptidase enzyme, Zn metal is coordinated with:

(a) Two histidine, 1 glutanic acid and H_2O molecule.

(b) 3 histidine, and H_2O molecule.

(c) 2 cysteine, 1 histidine and H_2O molecule.

(d) Two histidine, 1 cysteine and H_2O molecule.

112Ans.(a)

113 In liver alcohol dehydrogenase enzyme. The metal is coordinated with:

(a) 1 histidine, 1 cysteine, 2 glutamic acid and H_2O molecule.

(b) 3 histidine and H_2O molecule.

(c) 1 histidine, 2 cysteine and H_2O molecule.

(d) 2 histidine, 1 glutamic acid and H_2O molecule.

113Ans.(c)

114 (a) Zn^{+2} cannot be replaced by any metal ion.

(b) Zn^{+2} can be replaced by CO^{+2} ion.

(c) Zn^{+2} does not give d-d electron absorption spectral bands in the visible region.

(d) CO^{+2} show absorption bands from which valuable information about metal ion environment in the enzyme can be obtained.

Which one is correct?

(i) (a), (c), (d) (ii) (b), (c), (d) (iii) (a), (c) (iv) (b), (d)

114Ans.(iii)

MSQ (BIOINORGANIC)

1. Out of the following trace elements is/are:

(a) Mo, W (b) W, Na (c) B, Si (d) Se, K

1Sol. Option (a) and (c) are correct.

In option (b) and (d) Na and K are macronutrients.

2. Number of π-bonds in porphine molecule:

(a) 11 bonds in total and $22e^{\Theta}$ present

(b) 11 bonds in total but only $18e^{\Theta}$'s participating in conjugation.

(c) a bonds in total but $22e^{\Theta}$'s participating in conjugation.

(d) a bonds in total and $18e^{\Theta}$'s participating in conjugation.

2Sol. Option (a) and (b) are correct.

Total 11 bonds and $22e^{\Theta}$'s are present in porphone molecule but only $18e^{\Theta}$'s participate in conjugation.

3. Type of transition possible in porphyrin ring.

(a) $\pi - \sigma^*$ (b) $\sigma - \pi^*$ (c) $\pi - \pi^*$ (d) $n - \pi^*$

3Sol. Option (c) and (d) is correct.

As porphyrin ring has lone-pair as well as π-bonds hence $\pi - \pi^*$ and $n - \pi^*$ transitions are possible.

4. Which of these represents heme group?

(a) Iron-protoporphyrin ring (b) dianion-porphyrin ring + $Fe^{2+/3}$

(c) Prosthetic group. (d) Corrin ring + $Fe^{+2/+3}$

4Sol. Option (a), (b) and (c) are correct.

5. Statements that is true about myoglobin is:

(a) Present in tissue with Fe^{+2} as active site

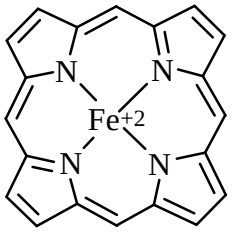
(b) Present in bone marrow with Fe^{+2} as active site.

(c) Heme group present.

(d) α-helix structure where globin chain have 153 amino acids.

5Sol. Option (a) and (c) and (d) are correct.

Structure of myoglobin is



→ deoxymyoglobin

→ It is present in tissues where its function is to store O_2.

→ It has α-helix structure and one molecule contains one heme group and one globin protein.

→ Globin chain contains 153 amino acids.

6. Correct statement is:

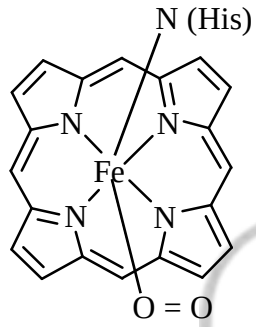
(a) O_2 binds in myoglobin alternate to N(His) group.

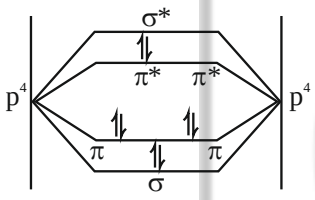
(b) O_2 binds in myoglobin alternate to Cys group.

(c) O_2 binds in singlet and bent form.

(d) O_2 binds in triplet and bent form.

6Sol. Option (a) and (c) is correct.





$$S = \frac{1}{2} - \frac{1}{2} = 0$$

$\boxed{2s+1 \Rightarrow 1}$ singlet state

→ Here O_2 has π-bond in singlet forms.

→ If O_2 is singlet than it act as strong fields.

→ When it binds with Fe, Pe will become low spin and bird in bent form of bind distal protein.

7. Cooperativity effect in hemoglobin.

(a) increases the affinity of O_2 binding.

(b) decrease the affinity of O_2 binding

(c) Breaks the salt bridges by binding O_2.

(d) Fe will be in high spin after O_2 binding and salt bridges break.

7 Sol. Option (a) and (c) are correct

Hemoglobin contains 4 myglobin units that are connected through salt bridges with each other.

As O_2 binds with one unit of hemoglobin the bridge breaks and the affinity of O_2 binding on the next unit increases.

8. The oxyhemoglobin:

(a) Fe(II) is in low spin (b) Fe(III) is in low spin

(c) Fe(II) and diamagnetic (d) Fe(III) and paramagnetic

8. Sol. Option (b) and (c) are correct.

O_2 binds Fe comes in low spin and oxidation state becomes (+3) and O_2 becomes O_2^-. The electron of Fe(III) and O_2 gets paired and shows anti ferromagnetic coupling coupling and becomes diamagnetic.

9. Statement that is incorrect is/are

(a) Binding capacity of myoglobin is depend on pH.

(b) Binding capacity of hemoglobin is dependent on pH.

(c) Hemoglobin has sigmoidal curve.

(d) Myglobin has sigmoidal curve.

9.Sol. (a) and (b) are correct option

→ Binding capacity of myoglobin is independent of pH.

→ Myoglobin has typerbolic curve.

10. Bisphosphoglycerate has

(a) no effect on O_2 binding in tissues.

(b) no effect on O_2 binding in lungs.

(c) Removes O_2 fit itself in cavity of hemoglobin.

(d) Size is 5Å.

10.Sol. → Size of BPG is 9Å.

→ And size of cavity is 5Å.

Hence BPG removes O_2 bind itself in the cavity by increasing its size.

→ It lungs pressure is high hence O_2 binding is preferred.

11. There are:

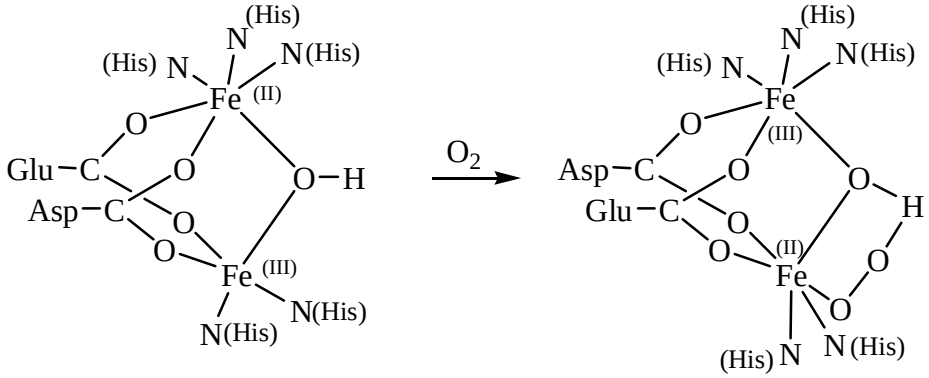
(a) 2 Fe centres in hemerythrin

(b) 1 Fe centre in hemerythrin

(c) O_2 is hydrogen bonded

(d) Coordination number of Fe is 6 in deoxy and oxy form.

11. Sol. Option (a) and (d) is correct.

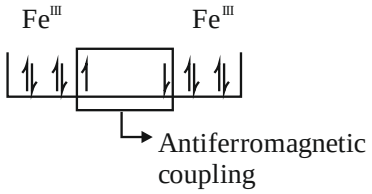


12. Both Fe in hemerythrin

(a) shows anti-ferromagnetic coupling (d) do not slow antiferromagnetic

(c) has high spin (d) hs low spin

12.Sol. Option (a) and (d) are correct.



13 Hemerythrin is:

(a) Non-heme protein (b) a octameric form

(c) Present in marine invertebrates (d) dioxygen binding pigment

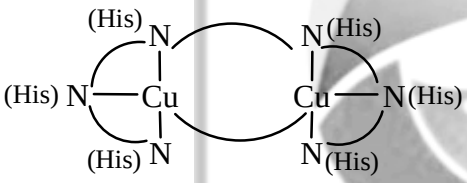
13 Ans. (a, b, c, d)

14. Correct statement regarding hemocyanin

(a) involved in Fe transport (b) Has heme group

(c) Copper containing protein (d) 6 imidazole ring containing protein attached.

14.Sol. Option (c) and (d) are correct.

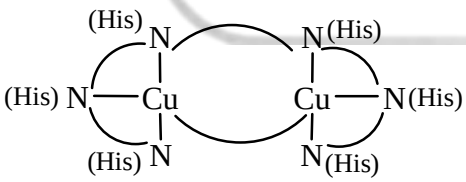


15. Following is a type of copper protein

(a) Hemocyanin (b) ceruloplasmin (d) plastocyanin (d) Hemerythrin

15.Sol. (a), (b) and (c) are correct.

(a)



Hemocyanin

(b) ceruloplasmin is made up of

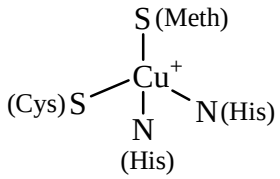
Three type 1

One type 2

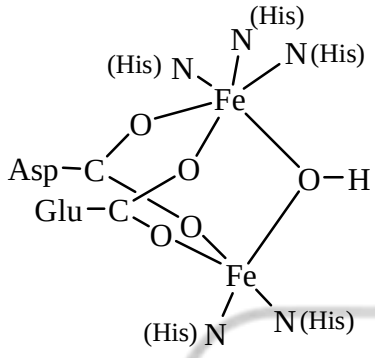
Two type 3

Copper proteins

(c) plastocyanin:



(d)



16. Zn can be replaced in Cu – Zn SoD (superoxide dismutase) by:

(a) Cobalt (b) cadmium (c) copper (d) gold

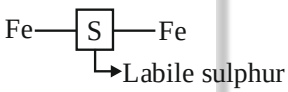
16.Sol. Zn^{2+} provides stability to Cu^{2+}. This can also be done by cobalt and cadmium.

Option (a) and (b) is correct.

17. Labile sulphurs are also known as:

(a) Inorganic sulphurs (b) Bridge sulphur (c) organic sulphur (d) None

17.Sol. Option (a) and (b) is corrrect.

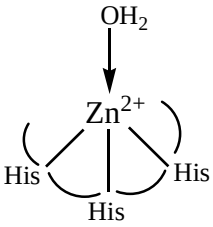


18. In carbonic anhydrase:

(a) Active site is Zn^{2+} (b) Active site in OH

(c) CO_2 is electrophile (d) Zn^{2+} increases the acidic strength of H_2O.

18.Sol. Option (b), (c) and (d) are correct.

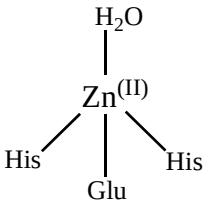


19. Carboxypeptidase

(a) hydrolysis peptide bond at N-terminal (b) hydrolyse peptide bond at C-terminal

(c) has Zn^{+2} metal (d) has trigonal bipyramidal structure

19.Sol. Option (b) , (c) is correct.



Use in hydrolysis of peptide bond at C-terminal.

20 (a) Cytochrome P-450 is a membrane bound enzyme.

(b) Cytochrome P-450 found in animals, bacteria and plants.

(c) It contain high spin Fe(III) in heme group.

(d) It catalyses hydroxylation of drugs, steroids, etc.

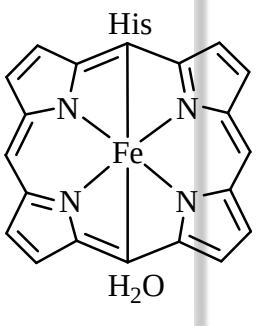
20.Ans.(a), (b), (d)

21. Peroxidase enzyme:

(a) Has heme group (b) Has Octahedral complex

(c) high spin (d) low spin

21.Sol. Option (a), (b), (c) are correct.



22. Oxygen cleaved in cytochrome p450 is

(a) used in formation of epoxide (b) used in formation of alcohol

(c) used in formation of carboxylic acid (d) used in formation of H_2O

22. Sol. Option (a), (b), (c) and (d) is correct.

23. Cytochrome P-450

(a) absorbs light at 450 nm (b) involves $2e^{\ominus}$ and 4 protons

(d) involves $2e^{\ominus}$ and 2 protons (d) cleave O_2 or dissociate O_2

23.Sol. Option (a), (b), (c) and 9d) are correct.

24. Transferrin can:

(a) only bind Fe in +3 oxidation state (b) Transport Fe from stomach to bone marrow

(c) Stores Fe in bone marrow (d) None

24.Sol. Option (a), (b) and (c) are correct.

25. Apoferritin contains:

(a) 153 amino acids in 24 protein chains

(b) 175 amino acids in 24 protein chains

(c) 100 Å diameter of hollow sphere of 24 protein chains

(d) 50 Å diameter of hollow sphere of 24 protein chains

25.Sol. Option (b) and (c) are correct.

26. Nitrogenase enzyme out at the following is/are:

(a) Vanadium nitrogenase (b) Iron Nitrogenase

(c) Copper nitrogenase (d) Molybdenum Nitrogenase

26.Sol. Option (a), (b) and (d) are correct.

27. Anticancer drug is:

(a) cis platin (b) carboplatin (c) Transplattin (d) Oxaliplatin

27.Sol. (a), (b) and (d) are correct.

28. Anti arthritis drugs are:

(a) Myochrysin (b) Auranofin (c) Carboplatin (d) Oxaliplatin

28.Sol. Option (a) and (b) are correct.

Gold complexes used most successfully for the treatment of arthritic disorders in humans.

29 Factors affecting binding capacity of O_2 in Hemoglobin are

(a) pH (b) Temperature

(c) Bisphosphoglycerate (d) (a) and (b) both

29.Sol. Option (a) and (c) are correct.

In hemoglobin the binding capacity of O_2 in hemoglobin.

30. Fluorapatite used str5ucturally in

(a) Brachiopod shells (b) Principle strengthening material in teeth

(c) Reduction of caries (d) All of these

30.Ans. (a, c)

31 Vitamin B-12 is:

(a) The only vitamin known to contain a metal

(b) Nature's only organometallic compounds

(c) Not found in the higher plants

(d) Exclusively not synthesised by bacteria

31.Ans. (a, b, c)

32 Hemerythrin has:

(a) 2Fe atom (whether monomer or octamer)

(b) 2Fe(III) atoms are in different environment

(c) 4Fe atom

(d) Oxygen attach in peroxide form (O_2^{2-})

32. Ans. (a, b, d)

33. $Hg^{(II)}$ shows:

(a) High affinity towards histidine (b) high affinity towards sulphur of cystein

(c) Congener of Zn(II) (d) Larger than Zn(II) hence works more efficiency.

33.Sol. (b) and (c) are correct.

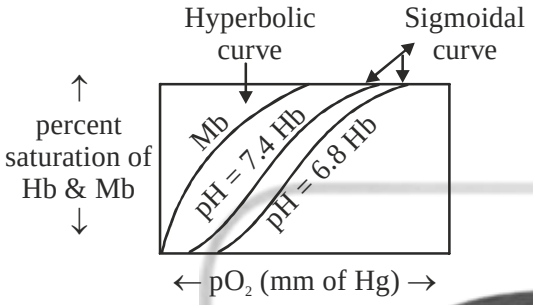
Larger size of Hg(II) hence when replaces Zn(II) works inefficiently and activity of enzyme is lost all together.

34. Hemoglobin gives sigmoidal curve of pH

(a) 7.4 (b) 6.8 (c) 5.0 (d) 8.2

34.Ans. a, b

34 Sol.



So, correct option is (a, b)

35. One molecule of myoglobin contains.

(a) One heme group and one globin protein

(b) One globin protein containing 153 amino acids

(c) 2 heme groups and 2 globin proteins

(d) 4 heme groups and 3 globin proteins

35.Ans. a, b

35. Sol. One molecule of myoglobin contains one heme group and one globin protein and each globin protein contains 153 amino acids.

So, correct option is (a and b)

36. In deoxyhemoglobin

(a) State is tensed state due to salt bridges

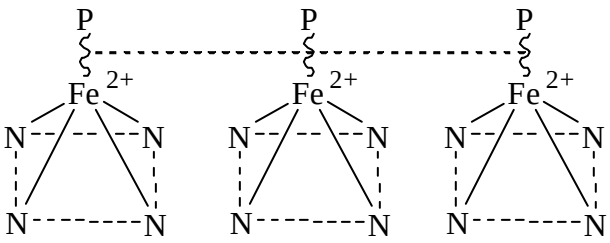
(b) It is difficult to bind O_2 to Hb in T-state

(c) When O_2 binds, the state in bridges break

(d) In deoxyhemoglobin the state is relaxed state.

36.Ans. a, b, c

36. Sol.



Deoxyhemoglobin is in T-state (tensed state due to salt bridges)

It is difficult to bind O_2 in this state

When O_2 binds to Hemoglobin, the state in bridges break and the molecule is said to be in relaxed state (R-state)

So, correct option is (a, b and c)

37. The color of :

(a) Deoxyhemoglobin is violet-blue

(b) Oxyhemoglobin is red

(c) The colour of both Hb and Hb $(O_2)_4$ is due to intraligand $\pi - \pi^*$ transitions.

(d) deoxyhemoglobin is red

37.Ans. a, b, c

37. Sol. Option a, b, c are correct.

38. Most of the CO_2 is transported in the form of

(a) HCO_3^{Θ} ions

(b) HCO_3^{Θ} and CO_2 enters the leukocyte

(c) HCO_3^{Θ} and CO_2 enters the erythrocytes

(d) HCO_3^{Θ} and CO_2 enters the red blood cells.

38.Ans, c, d

38.Sol. Most of the CO_2 is transported in the form of soluble HCO_3^{Θ} ions. CO_2 enters the erythrocytes (RBC) where the enzyme carbonic anhydrase converts it to H_2CO_3 which dissociates into the HCO_3^{Θ} and H^+ ions.

39. Correct statement regarding dioxygen binding is/are:

(a) Myoglobin has stronger affinity for dioxygen binding than hemolgobin

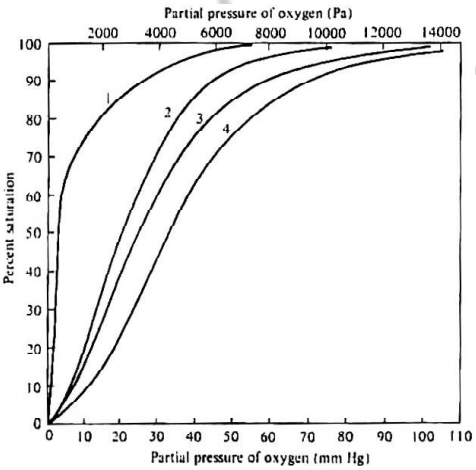
(b) The binding of dioxygen is more pronounced in the presence of large amount of carbondioxide.

(c) Hemoglobin has stronger affinity for O_2 binding than myglobin

(d) The binding of O_2 is more pronounced in less amount of CO_2.

39.Ans. a, b

39.Sol.



Dioxygen binding curves for (1) myoglobin and for hemoglobin at various partial pressures of carbon dioxide: (2)

20 mm Hg; (3) 40 mm Hg; (4) 80 mm Hg. Note that myoglobin has a stronger affinity for dioxygen than hemoglobin and that this effect is more pronounced in the presence of large amounts of carbon dioxide.

40. Which of the following is true:

(a) Fe(II) is in high spin and diamagnetic in Hemerythrin

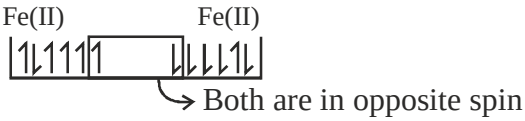
(b) Fe(III) is in low spin and is diamagnetic in oxyhemerythrin

(c) Fe(II) is ESR inactive in deoxyhemerythrin

(d) Fe(III) is ESR inactive in Hemerythrin

40 Ans. (a, b, c, d)

40 Sol. Fe(II) is in high spin $\rightarrow t_{2g}^4 e_g^2$



$\therefore$ Antiferromagnetic coupling

Hence becomes diamagnetic and ESR inactive

$t_{2g}^5 e_g^0$

Similarly for Fe(III) Low spin

41. Function of Hemocyanin is

(a) O_2 transport in some invertibrates mollusca

(b) O_2 transport in some arthopoda

(c) O_2 storage in marine invertibrates

(d) e^- transport in plants and animals

41Ans. (a, b)

41Sol. The function of Hemocyanine is O_2 transport in some invertibrates mollusca (eg.: snails, squid) and arthopoda (eg.: crabs, cobsten, shrimis)

42. In oxyhemocyanin copper is:

(a) Cu(II), diamagnetic, colourless, EPR inactive

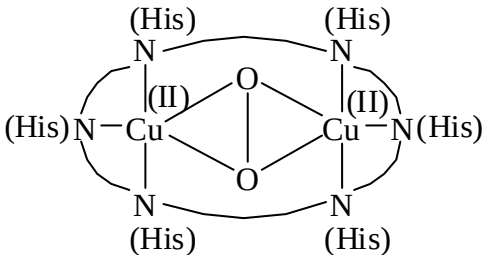
(b) Cu(I), diamagnetic, coloursless EPR inactive

(c) Cu(II), diamagnetic, blue colour, EPR inactive

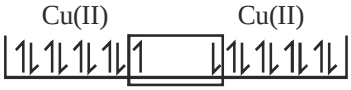
(d) Cu(II), diamagnetic, blue colour, colour due to O_2^{2-} to Cu^{2+} (LMCT), EPR inactive

42Ans. (c, d)

42.Sol. In oxyhemocyanin.



Cu(II) is diamagnetic due to antiferro magnetic coupling



- Blue colour is due to bridged $O_2^{2-} - Cu^{2+}$ LMCT
- It is EPR inactive

43. Mn(IV) cluster is

(a) oxygen evolving complex (b) oxidizing agent

(c) Convert into Mn(III) by getting e^{Θ} from H_2O.

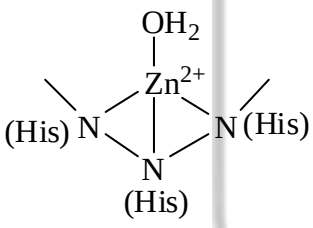
(d) Releasing $4e^{\Theta}$ and giving to PS-II

43 Sol. Option (a), (b), (c), (d) are correct.

44. Carbonic anhydrase is

(a) Tetrahedral (b) Colourless (c) diamagnetic (d) None

44.Sol.



→ Tetrahedral structure

→ Colourless → No d–d transition, No LMCT

→ diamagnetic → $\boxed{3d^{10}4s^0}$ → Zn^{+2}

Option (a), (b) and (c) are correct.

45 Out of the following options macronutrients is/are :

(a) H (b) C (d) Mo (d) Na

45.Sol. Elements which are required in large amount are called macronutrients.

Option (a), (b), (d) are correct.

46 Out of the following which elements are trace elements

(a) Sc (b) Ti (c) V (d) Mo

46 Sol. Elements which are required in small amount are called trace elements.

Option (c) and (d) are correct.

47 Out of the following which are ultra trace elements :

(a) Pd (b) Cd (c) Ax (d) Na

47Sol. The elements which are required in very small amounts are called ultra trace elements.

Option (a), b) and (c) are correct.

48. The metal ion in carboxy peptidase–A is coordinated to :

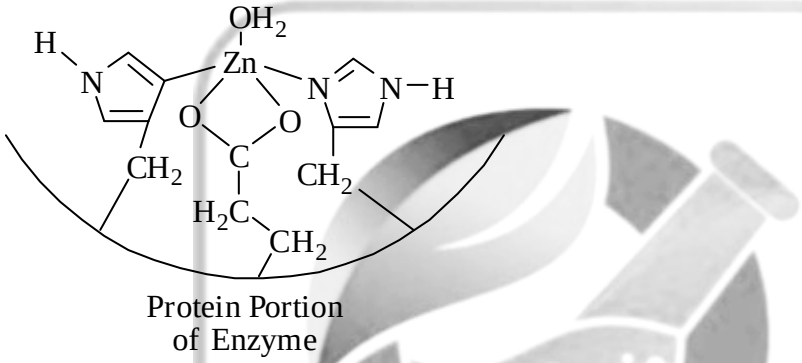
(a) 2-Nitrogen atoms of two histidine residues

(b) A glutamate residue

(c) A water molecule

(d) None

48Sol.



Option (a), (b), (c) are correct.

49 Cytochrome P_{450} is found in

(a) Plants (b) Animals (c) Bacteria (d) Air

49Ans. a, b, c

Sol. Cytochrome P_{450} are a group of cytochromes found in plants, animals and bacteria.

50 Cytochrome P_{450} has:

(a) Fe (III) state (b) Low spin Fe(III)

(c) Octahedral (d) 6 Coordination no. of Fe(III)

50 Ans. a, b, c, d

50. Sol. The active site in cytochrome P-450 in heme similar to hemoglobin and myoglobin except that:

1. Fe is present in Fe(III) state and it is low spin octahedral

2. One s-atom of cysteine is coordinated to Fe(III) instead of histidine in the proximal position.

3. Sixth coordination site is occupied by H_2O.

51. Ferridoxins classfied as:

(a) $Fe_2 S_2$ Ferredoxins (b) Fe_3S_4 Ferredoxins

(c) Fe_4S_4 Ferredoxins (d) Fe_2S_4 Ferredoxins

51.Ans. a, b, c

51 Sol. Ferridoxins is classified as three major catagories: Fe_2S_2 or 2Fe – 2s, Fe_3S_4 or 3Fe – 4s and 4Fe – 4s or Fe_4S_4 Ferredoxins.

52. Porphyring ring:

(a) have 3 signals in ^1H NMR.

(b) ν_{N-H} varies between 3200 – 3300 cm^{-1}.

(c) is deeply coloured due to ligand metal charge transition

(d) In UV spectroscopy shows two bands (soret and Q-band)

52Ans. (a, b, d)

53. In Met-Haemoglobin

(a) Both Fe(II) and Fe(III) present

(b) Iron only present in Fe(III) state

(c) Present in a trace amount (~3%) in human blood.

(d) Higher level of methemoglobin causes a disease called as methemoglobinemion, it is a disorder

53.Ans. (b, c, d)

54. (a) The ligands such as CO, CN^-, NO, PF_3 are strong π-acceptor than O_2.

(b) Such ligands can bind to Fe(II) centre more strongly than O_2.

(c) It prevents the transport of O_2 and causes death eventually due to Asphyxia.

(d) CO binding is 200 times more stronger than O_2 binding

54.Ans. (a, b, c, d)

55 Bacteria/s that produces Nitrogenase enzyme is :-

(a) Rhizobium (b) Vibrio cholerae

(c) Treponema pannidum (d) Azobacter vinelandii

55Sol. Rhizobium and Azotobacter vinelandii are 2 bacterias that produce enzyme called nitrogenase engyme.

Option (a) and (d) are correct options.

56 Out of the following enzymes nitrogenase enzyme is :-

(a) Vanadium Nitrogenase (b) Iron Nitrogenase

(c) Copper Nitrogenase (d) Molybdenum Nitrogenase

56Sol. Option (a), (b) and (d) are correct.

57 Component of Ferritin is/are :

(a) Protein coat (apoferritin) (b) Transferrin

(c) Iron core (d) Ferridoxin

57Sol. Two components of Ferritin are (1) Protein coat (apoferrition) (2) Iron core.

Option (a) and (c) is correct.

58 If globin chain is not present than heme group will convert into

(a) μ-oxodimer (b) μ-peroxodimer (c) hematin (d) BrFe(II)-Ö-Ö

58Sol. Option (a) and (c) is correct.

μ-oxodimer or hematin (another name) is formed no-globin protein is present.

59. Hb picks oxygen from

(a) Liver (b) Blood (c) Lungs (d) Gills

59Sol. Option (c) is correct and option (d).

60 Fe^{3+} reduced in Fe^{2+} in bone marrow so that it can be released from transferrin. It is done by

(a) Cytochromes (b) oxidation of pyruvate

(c) ceruloplasmin (d) Ferroxidase

60Ans. Option (a) and (b) are correct.

60Sol. $\rightarrow Fe^{3+} + e^{\Theta} \xrightarrow{\text{Reduction in bone marrow}} Fe^{2+}$

(This e^{Θ} either from cytochromes or by oxidation of pyruvate).

$\rightarrow Fe^{2+}$ is released easily from transferrin)

61 Cytochrome–C oxidase is the

(a) terminal membrane of cytochrome chain.

(b) Binds the inner membrane of mitochondrion

(c) Contains cytachrome-a, cytochrome a_3, and two Cu(II) ions (Cu_A and Cu_B)

(d) Are the middle part of the cytochrome chain

61Ans. Option a, b, c are correct.

61.Sol. Cytochrome – C-oxidase, terminal member of cytochrome chain which binds the inner membrane of the mitochondrian contains cytochrome-a, cytochrome-a_3, and two Cu (II) ions (Cu_A and Cu_B)

62 Across mitochondrial membrane cytochrome chains involves

(a) electrons (b) protons (c) Fe (d) None

62.Ans. (a) and (b) are correct

62.Sol. $4CytC^{2+} + 8H^{+}_{inside} + O^{\Theta}_{2_{outside}} \rightarrow 4Cyt^{3+}C + 2H_2O^{2\Theta} + 4H^{+}_{outside}$

This indicates that cytochrome chain involves transport not only of e^{Θ}. But also of protons, across mitochondrial membrane.

62.Sol. Correct option is (a)

63. The biological systems the metal ions involved in electron transport are

(a) Na^{+} (b) Cu^{2+} (c) Ne^{3+} (d) Ca^{2+}

63.Ans. (b and c)

64. Among the following pair of metal ions present in nature. The first one functions as on electron transfer agent and the second or catalyzes the hydrolysis reactions. The correct pair is:

(a) Fe and Zn (b) Mg and Fe (c) Co and Mo (d) Ca and Cu

64Ans. (a)

65. Mg^{2+} is prefered in photosynthesis by chlorophyll because

(a) It has strong spin orbit coupling (b) It has weak spin-orbit coupling

(c) It is a heavy with metal (d) It binds strongly with chlorophyll

65Ans. (d)

66. The active site of enzyme nitrogenase contains.

(a) Mo (b) Mn (c) Fe (d) Cu

66Ans. (a)

67. Which of the following is A heme ions proteins?

(a) Rubredoxin (b) Transferrin (c) Hemerythrin (d) Cytochrome C

67Ans. (d)

68. Mercury find its compounds is toxic due to their

(a) High affinity for thiols (b) Interference O_2 transport.

(c) Binding to histidine (d) Inhibition of vitamin B_{12} synthesis

68Ans. (a)1

69. Consider the following statement of metallothionein:

(a) They contains about 30% cysteine residues

(b) They prefer to bind soft metal ions such as Cl(11), Hg(11), Zn(11)

(c) They are involved in electron transfer reactions

(d) They are low molecular weight proteins

69Ans. (a, b, and d)

70 The type of bacterial siderophores are:

(a) desferrichrome (b) desferrioxamine B

(c) enterobactin (d) azobacter-vinelandii

70Ans. a, b, c

71. Deoxyhaemoglobin is:

(a) five coordinated complex

(b) high spin complex

(c) Fe^{+2} state and four of coordination position are occupied by porphyrin ring N-atom

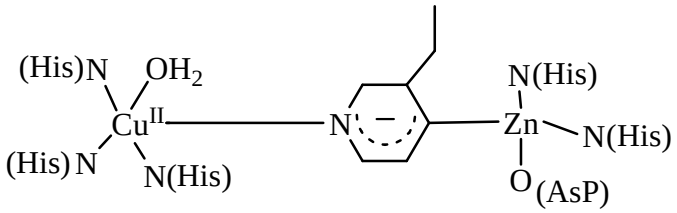
(d) Red in colour

71Ans. (a, b, c)

72 In Cu–Zn Superoxide Dismutase Zn^{2+} can be replaced by

(a) Co (b) Cd (c) Ni (d) Fe

72Sol. option (a) and (b) is correct.



Zn^{2+} provides stability to Cu^{2+} and can be replaced by Co and Cd.

73 Chelates used in chelate therapy in case of wilson's disease

(a) D-penicillamine (b) British-Anti-Lewisite (BAL)

(c) EDTA (d) Tetrathiomolybdate

73Ans. Correct options are (a, b, c and d)

74 Which statements is/are true for hill constant values:

(a) n = 1; means O_2 intakes by 1 heme group of haemoglobin is totally independent of oxygen intake of its other 3 heme group.

(b) n = 4; means Hb and $Hb(O_2)_4$ are ultimate participants in the oxygenation of haemoglobin.

(c) $4 < n < 1$; means that the attachment of O_2 to 1 haeme on n = 2.8; group of Hb progressively ↑se its tendency to bind with subsequent heme group of haemoglobin.

75Ans. (a), (b), (c)

76 Active site in Iron-sulpher protein:

(a) Fe (+2) (b) Fe (+4) (c) Fe (+3) (d) S^{2-}d

76. (a,c)

76Sol. option (a) and (c) are correct.

Fe in (+2) and (+3) are the Active sites of Iron-sulphur proteins.

77 Function of LADH metallo enzyme is to

(a) Convert primary alcohol to aldehyde.

(b) Convert secondary alcohol to ketone.

(c) Catalyse the oxidation of any compound in presence of H_2O_2.

(d) Dissociation of O_2.

77. (a,b)

77 Sol. Correct options are (a and b)

78 Nature has use Zn^{2+} metal ion at the active site of many hydrolytic enzyme because:

(a) Zinc is only in +2 oxidation state (b) It is redox inactive

(c) Zinc only makes tetrahedral geometry (d) Zinc is good Lewis acid..

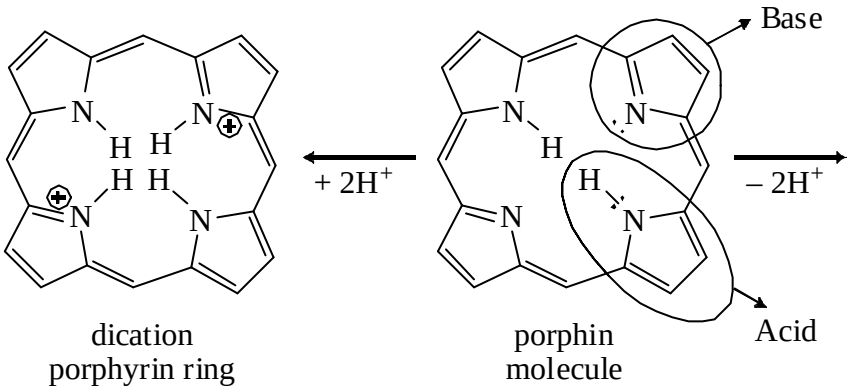
78Sol. Correct options are (a, b, c and d)

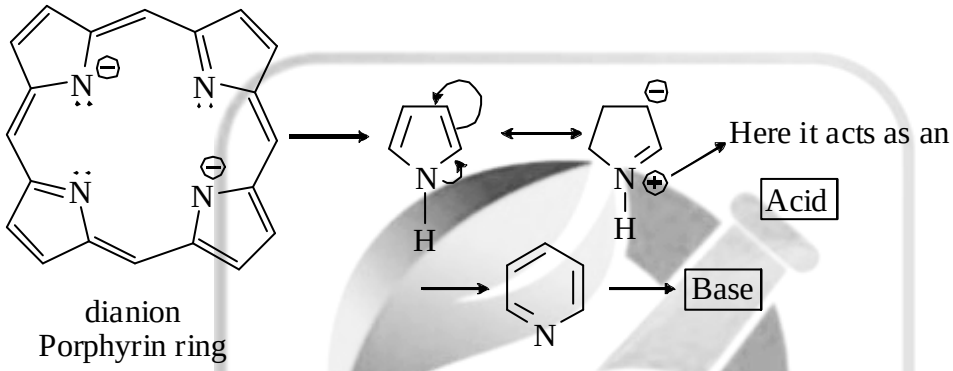
NAT

1. _____ nitrogen act as acid in porphin molecule, _____ dianionion porphyrin ring, _____ dication porphyrin molecule, respectively?

Ans. 2, 0, 4 respectively

Sol. Porphyrin ring is a derivative of porphyrin molecule.





2. Each hemoglobin molecule is made up of _____ sub units and α – globin protein consists of ____ and β-globin protein consists of _____ amino acids.

Sol. Four, 141, 146 is the correct answer.

Each hemoglobin molecule is made up of four subunits, each of which consists of a globin protein in the form of folded helix or spiral.

The globin proteins are of 2 types: two are α and two are β. An α globin protein consists of 141 and β-consists of 146 amino acids.

3 Raman stretching frequency ν_{O-O} in oxyhemoglobin is_____.

Ans. 1300 cm^{-1}

Sol. Correct answer is 1300 cm^{-1}.

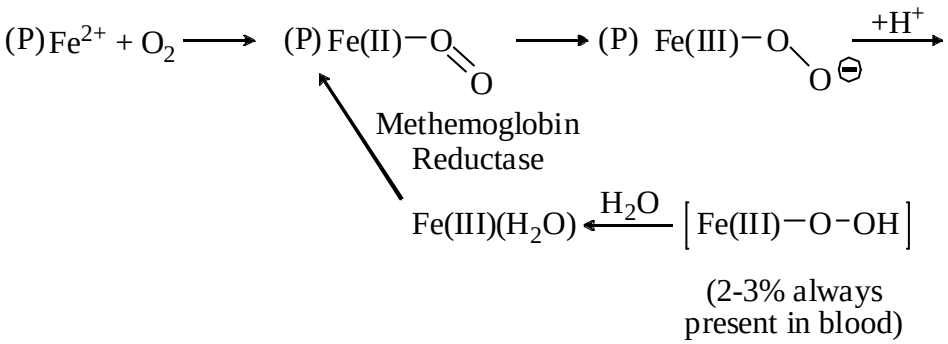
4 In methemoglobin the oxidation state of iron is _____.

Sol. +3

5. In human blood _____ methemoglobin is produced normally

Ans. 2-3%

Sol.



In human blood a trace amount of (about 3%) of methemoglobin is normally produced spontaneously.

6. The Raman stretching frequency of oxyhemerythrin is_____.

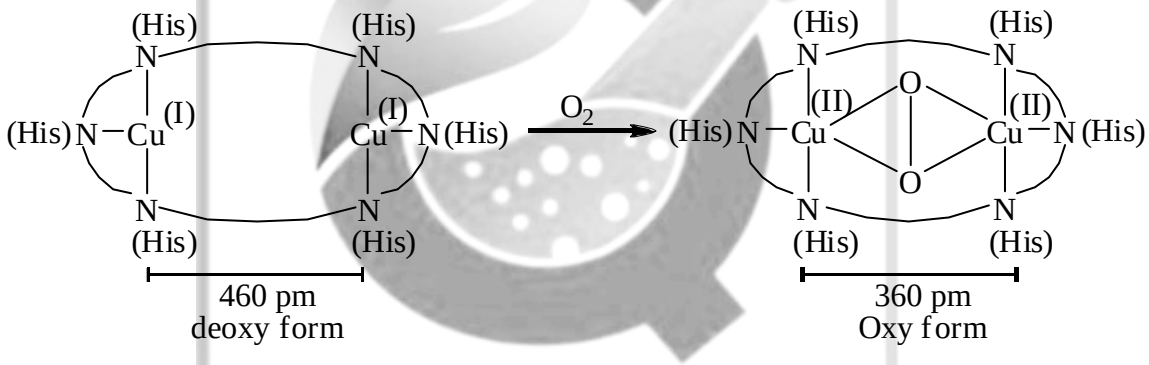
Ans. 845 cm^{-1}

sol. Raman stretching (ν) ν_{O-O} in oxyhemerythrin is 845 cm^{-1}

7. The distance between Cu–Cu in deoxyhemocyanin is _____ and in oxyhemocyanin is _____

Ans. 460 pm and 360 pm

Sol. 460 pm in deoxyhemocyanin and 360 pm in oxyhemocyanin.



8. ____ types of photosystems are present in chloroplasts in photosynthesis of plants?

Ans. 2

Sol. There are 2 types of photosystems in chloroplasts :

PS – I and PS – II

9. In Photosynthesis _____ no. of electrons are afforded for the transport ($H_2O \rightarrow \rightarrow NADP^+$)

Ans. 4

Sol. Total $4e^{\ominus}$ are afforded for the transport ($H_2O \rightarrow \rightarrow NADP_+^{)}$ or we can say four quanta of electrons are afforded.

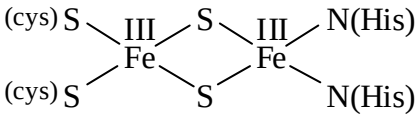
10 In cytochrome P_{450} metal is in oxidation state:

Ans. +3

Sol. In cytochrome P_{450} the active site is Fe^{+3}.

11. If ____ S(cys) are replaced by _____ N(His) in Fe_2S_2 ferridoxins than it is known as rieske centre.

Ans. 2, 2 respectively

Sol. 

12. Total number of double bonds present in porphyrin ring ____ and value of n according to Huckel theory ____ experimentally

Ans. (11 db, 4)

13. In equation $f = \frac{K_p(nO_2)}{1+K_p(nO_2)}$; value of n (Hill constant) for haemoglobin is ____

Ans. (2.8)

14. Number of options correct in case of peroxidase enzyme is _____.

(1) Heme group present (2) Octahedral complex

(3) High spin complex (Fe) (4) Decompose H_2O_2

Sol. Option (1), (2), (3) are correct

Correct answer is (3)

15 The catalyse metallo enzyme:

(a) is tetramer of aldehyde oxidase enzyme (b) dissociates O_2

(c) is tetramer of peroxidase enzyme (d) converts 1° alcohol to aldehyde

Sol. Catalyse metallo enzyme is a tetramer of peroxidase enzyme.

Correct option is (c)

16. The function of catalyse metallo enzyme is to:

(a) Decompose H_2O_2

(b) Catalyse the oxidation of any compound in presence of H_2O_2

(c) Dissociate O_2

(d) Isomerisation of dicarboxylic acid

Sol. $H_2O_2 + H_2O_2 \rightarrow O_2 + 2H_2O$

Correct option is (a)

17 The function of cytochrome P_{450} is:

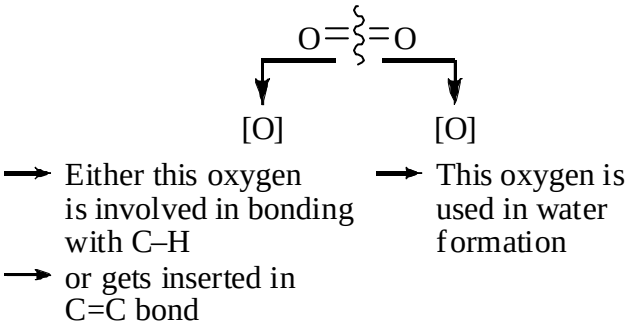
(a) Decompose H_2O_2

(b) Catalyse the oxidation of any compound in presence of H_2O_2

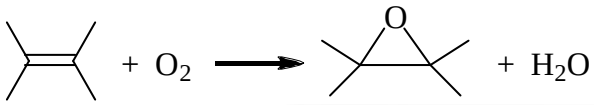
(c) Isomerisation of dicarboxylic acid

(d) Dissociate O_2

Sol.



Correct option is (d)

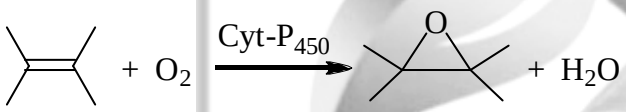
18 

epoxide

Enzyme responsible for this reaction is:

(a) Peroxidase enzyme (b) Cyt P_{450}

(c) Catalyse metallo enzyme (d) LADH enzyme

Sol. 

epoxide

Correct option is (b)

19. In cytochrome P_{450} how many protons and electrons are involved:

(a) 2 proton, 2 electron (b) 1 proton, 2 electron

(c) 2 electron, zero proton (d) 4 electron, 4 protons

Sol. In cytochrome-P_{450} 2 protons and 2 electrons are involved.

eg.: $R-\overset{\overset{O}{\|}}{C}-H + 2H^+ + 2e^{\ominus} + O_2 \xrightarrow{\text{Cyt-}P_{450}} R-\overset{\overset{O}{\|}}{C}-OH + H_2O$

Correct option is (a)

20 Hb binds _____ and then enters _____ enters into venus blood.

(a) H_2 CO_3, H^+ (b) Co_2, H^+ (c) H^+, HCO_3^- (d) O_2, H^+

Sol. Option (c) is correct.

Hb binds H^+ and HCO_3^- enters the venus blood. When carbonic anhydrase catalysis the conversion of CO_2 into HCO_3^- and H^+.

Hb picks oxygen from lungs or gills and move to muscle tissues through arterial blood.

21. In cytochrome C-oxidase Fe involved in electron transfer are _____ and Cu involved in reduction of O_2 are _____

Sol. Cytochrome C-oxidase has

$2Fe \rightarrow 1Fe$ in transfer of electron

and $\rightarrow$ 1Fe is involved in reduction of O_2.

$2Cu \rightarrow 1Cu$ is involved in transfer of electron

$\rightarrow$ 1Fe is involved in reduction of O_2

Correct answer is 1 and 1

22 Xanthine oxidase enzyme consist of:

(a) One Mo, $2Fe_2S_2$ and FAD (b) 2Mo, $2Fe_2S_2$ and FAD

(c) 2Mo, $1Fe_2S_2$ and FAD (d) 1Mo, $1Fe_2S_2$ and FAD

Sol. Xanthine oxidase enzyme consist of one Mo, $2Fe_2S_2$ and FAD.

Correct option is (a)

23. Electron flow in Xanthine oxidase is as

(a) Xanthine $\rightarrow$ Mo(IV) $\rightarrow$ Mo(VI) $\rightarrow 2Fe_2S_2 \rightarrow$ FAD $\rightarrow O_2$

(b) Xanthine $\rightarrow$ Mo(VI) $\rightarrow$ Mo(IV) $\rightarrow 2Fe_2S_2 \rightarrow$ FAD $\rightarrow O_2$

(c) Xanthine $\rightarrow 2FeS_2 \rightarrow$ Mo(VI) $\rightarrow$ Mo(VI) $\rightarrow$ FAD $\rightarrow O_2$

(d) Xanthine $\rightarrow$ FAD $\rightarrow$ Mo(IV) $\rightarrow$ Mo(VI) $\rightarrow 2Fe_2S_2 \rightarrow O_2$

Sol. Electron flow takes place as:

Xanthine $\rightarrow$ Mo(VI) $\rightarrow$ Mo(IV) $\rightarrow 2Fe_2S_2 \rightarrow$ FAD $\rightarrow O_2$

Function:

Mo(VI) $\rightarrow$ transfer of O_2 to the substrate

Mo(IV) $\rightarrow$ abstract of O_2 from the substrate

$Fe_2S_2 \rightarrow$ electron transfer

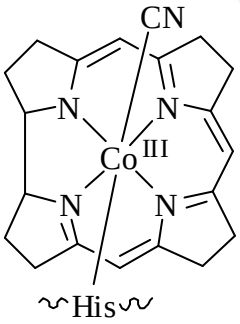
FAD $\rightarrow$ it change the reduction and oxidation potential of protein chain.

Correct option is (b)

24. Ring present in vitamin B_{12} is:

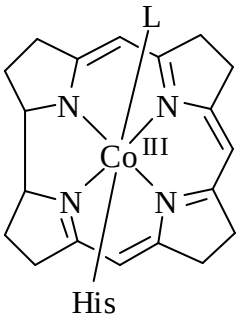
(a) Porphyrin ring (b) Chlorin ring (c) Corrin ring (d) No ring is present

Sol.



Correct option is (c)

25. Structure of co-enzyme B_{12} is when L is:



(a) L = OH^{Θ} (b) L = CN^{Θ} (c) L = adenosyl (d) L = CH_3

Sol. Correct option is (c)

26 Function of vitamin B_{12} is

(a) Isomerisation of dicarboxylic acid (b) O_2 cleavage

(c) decompose H_2O_2 (d) 1,3 carbon shifting

Sol. Function of vitamin B_{12} is to isomerise dicarboxylic acid

eg.: Glutamic acid → B-methyl aspartic acid

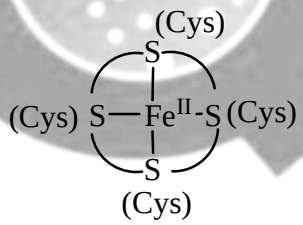
Correct option is (a)

27 Iron in deoxymyoglobin is in _____ oxidation state.

Ans. (+2)

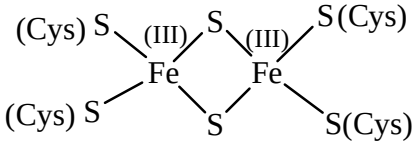
28 Number of Labile sulphur present in Rubredoxin are:

Sol. Ruberdoxin → (FeSo) has zero Labile sulphurs.



29 2Fe – 25 has how many labile sulphurs:

Sol. (b)



30. Tyrosine is:

(a) involved in the formation of skin pigment melanin

(b) oxidation of Co^{II} to Co^{III}

(c) has 2Cu centered oxygenase enzyme

(d) convert vicinal diol to aldehyde

Sol. Correct option is (a)

31. Tyrosine:

(a) Reduces P_{680}^{+} and P_{700}^{+} to P_{680} and P_{700} respectively

(b) Oxidises Co^{II} to Co^{III}

(c) Covert vicinal diol to aldehyde

(d) Oxidises Mg to Mg^{2+}

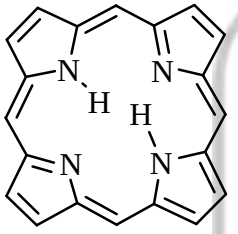
32 Total macronutrients out of hydrogen, carbon, nitrogen, sodium, magnesium, potassium, molybedenum, Tungsten are_____.

Sol. Molybedenum and Tungsten are trace elements

Hence total macronutrients are 6.

33 Number of pyrole units in prophin molecule are _____?

Sol. Total four pyrole units are combined with a methine bridge in prophine molecule.



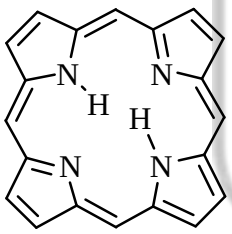
⟶ Porphin Molecule

34 Total number of bonds involved in conjugation making the porphine molecule aromatic are _____.

Sol. Total 9 bonds are involved in conjugation.

35 No. of signals in porphine molecule

Sol.



2 N – H given 1 signal

8 β – H given 1 signal

4 meso giving 1 signal.

Hence, total 13 signals present.

36 Chemical shift value of N – H is _____, Meso is _____ and β-hydrogen is ____ in porphine molecule.

Sol. –2 to –3 PPm for $\rightarrow \delta_{N-H}$

4.1 PPm for $\rightarrow \delta_{meso}$

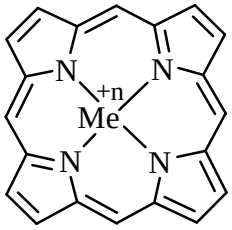
8.00 PPm for $\rightarrow \delta_{\beta-H}$

37 Number of transitions possible in porphine molecule in UV spectra _____.

Sol. Total 2-types of transitions are possible.

$\boxed{n-\pi^*}$ and $\boxed{\pi-\pi^*}$ transitions.

38 _____ six membered and ____ five membered rings are present in metalloporphyrin ring.

Sol.  → Metalloporphyrin

Total → 4–six membered and 4 → five-membered

39 Oxidation state of Fe in deoxymyoglobin is _____ and oxymyoglobin is ____.

Sol. In deoxymyoglobin the oxidation state is +2 and in oxymyoglobin the oxidation state is +2.

40 _____ are the amino acids in globin chain of myglobin.

Sol. Total 153 amino acids

50. Coordination number of Fe in oxymyoglobin is _____.

Sol. 6 is the coordination number.

51. ____ types of globin proteins are present in Hemoglobin.

Ans. 2 types of globin proteins → α and β

52. One α globin protein has _____ amino acids.

Ans. 141 amino acids.

53. ____ amino acids are present in one β globin protein in hemoglobin.

Sol. 146

54. Oxidation state iron in oxyhemoglobin is ____.

Ans. +3

55. Number of iron are ___ and oxidation state of iron is ____ in hematin.

Sol. 2 iron and +3 oxidation state.

56. ____ per cent of methemoglobin is always present in human body.

Sol. 3%

57. Size of BPG is around _____Å.

Sol. Size of Bisphosphoylycerate is around 9Å.

58. Ome molecules of hemerythrin has has ____ subunits.

Ans. One molecule of hemerythrin has 8 submits.

59. Each submit in hemerythrin has ____ amino acids and ____ iron centres.

Sol. 113 amino acids and 2 iron centres.

60. The distance between two copper units in oxyhemocyanin is _____Pm.

Sol. 360 Pm

61. ____ types of copper proteins are present in type 4 or multicopper proteins in which ___ are type 1, ____ are type 2 and _____ are 3 type 3 copper proteins.

Sol. 3 types of copper proteins.

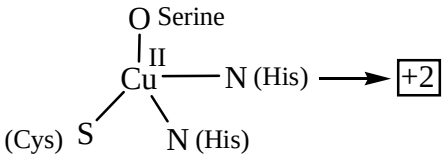
3 are type 1

1 is type 2

2 are type 3.

62. Oxidation state of copper in oxidized form of stellacyanin is ____.

Sol.

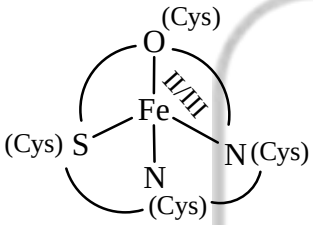


63. Number of labile sulphur is ____ and non-labile sulphur is _____ in rubredoxin.

Sol. Rubredoxin $\rightarrow$ FeSo

Here S represents labile sulphur which is zero.

and non-labile sulphurs are four.



64. _____ number of S(Cys) are replaced by N(His) in Fe_2S_2 to make rieske centre.

Sol. 2 S(Cys) are replace by N (His).

65 _____ are number of Irons and ____ are the number of copper in cytochrome-C-oxidase.

Sol. 2 Fe and 2 copper.

66 Oxidation state of cobalt in vitamin B_{12} is _____.

Sol. Cobalt exists in +3 oxidation state in vitamin B_{12}.

67 Both Nickel has oxidation state ____ in Urease.

Sol. +2 oxidation state.

68 Life of hemoglobin is ____ weeks.

Sol. 16 weeks

69. Siderophore protein used in transport of Fe metal in bacteria when Fe is in ____ oxidation state.

Ans. +3

70. Apoferritin contain ____ protein chains and____ amino acids and hashollow sphere with ____ Å.

Sol. 24 protein chains and 175 amino acidsand 100 Å diameter.

71. The hollow sphere is appoferritin contains____ hyprophillic and ____ hydrophobic channels.

Sol. 8 hydrophillicand 6 hydrophobic channels.

72 Transferrin binds iron in ____ oxidation state.

Sol. +3 oxidation state.

73 Ferritin binds iron in ____ oxidation state.

Sol. +3

74 Photosystem I absorbs light of ____ nm and photosystem II absorbs light at _____ nm.

Sol. 700 nm and 680 nm respectively.

75. ΔH for nitrogen fixation in Haber process is

Sol. – 50 kJ/mol

76 No. of π bonds are _____ but only _____ participate in conjugation in porphin ring to make it aromatic.

Sol. 11, 9 respectively.

77 _____ electrons are not participating in the conjugation in prophyrin/prophin ring.

Sol. 4 electrons

78 No. of signals in ^{1}HNMR in porphin ring :

(a) 2 (b) 3 (c) 8 (d) 10

Sol. No. of signals in porphin ring are (3) 2 (N – H) $\rightarrow$ 1 signal, 8β-H $\rightarrow$ 1 signal 4 meso H-1 signal $\rightarrow$ total 3 signals.

79 The size of cavity after binding of O_2 in hemoglobin is _____ to fit bisphosphoglycerate.

Sol. The size of cavity is 5Å.

80 In bacteria photosynthesis how many photosystems are at play ____.

Sol. Only 1 photosystem is at play in photosynthesis.

A

(a)

(b)

(a)

(b)